POWER

Established 1884—McGraw-Hill Publishing Company, Inc.
PHILIP W. SWAIN, *Editor*

July, 1934 Volume 78, Number 7

BALANCE

• THE WHOLE OF LIFE, and of nature itself, is but a problem of balance—much like the engineer's heat balance.

• TAKE POWER-PLANT DESIGN, for example. First cost is balanced against operating cost. Excess capacity is balanced against the probability and cost of a breakdown. Piping and heat insulation are sized to strike a happy medium between intolerable waste and too costly perfection. The same principle is applied to generating voltage and size of conductors.

• WATER PIPES AND TANKS are thickened for corrosion insurance, but not too much. Boilers have factors of safety, but within reason. Protective devices are installed for all probable hazards. More remote emergencies are left to be handled by executive skill, or to be absorbed in the give and take of business life—cheaper than perfect protection.

• THE HIGHEST OBTAINABLE EFFICIENCY is rarely the most worthwhile. The last inch of the high jump record takes more effort than the first five feet. Plant locations swing toward cool condensing water and cheap coal, but not too far from the load center. Superpower transmission lines extend their networks, but the distant village may be cheaper served by more costly local generation.

• BALANCE OF PROCESS HEAT AND POWER LOADS swings the factory to purchased power or to local generation. Budgets are adjusted to plans and expenditures are balanced to meet budgets. Repair parts are stocked, but not too many.

• IT IS THE SAME WITH LIFE ITSELF. We insure our lives but not our lead pencils. Parents welcome children, but not fifty. A day spent in play may sharpen the week's work, but steady loafing is ruinous. The job may benefit by an occasional day dream, but not too many. The benefits of close human control must be balanced against the killing of initiative through regimentation. Except in an autocracy, every plan, however "perfect," must compromise with human vagaries, never found twice in the same combination.

• THERE ARE TIMES TO CONCEDE and times to be utterly stubborn—the balance of values and of workabilities must determine which and when.

• THE ENGINEER, of all men, most needs a sense of balance, for he alone must work simultaneously with men and machines. He alone must adjust rigid mechanical systems to the prejudices, inertia, enthusiasms and stupidities of human nature.

• IF ONE LOOKS TO THE FUTURE of power generation and application, it seems inevitable that this need for balancing all decisions, all actions, will increase rather than diminish as time goes on. This will place a premium on engineering breadth and versatility. The day of narrow specialization will definitely pass for all engineers in key positions. In this new world, it will not suffice to be a good technician.

POWER DRAMA

THE JUNE NUMBER, as all readers are now aware, celebrated *Power's* Fiftieth Anniversary by telling the story of power generation, past and present, and then projecting the present into the imagined future. Today we start the long journey through the real future—*Power's* second half century. What is ahead? What new things will appear over new horizons? What strange gardens and deserts will be seen in the distance, passed through, and left behind? We do not know, but, judging by the past, will chance the guess that this will be a thrilling journey—a game well worth the candle.

PUSH-BUTTON PLANTS

TWENTY YEARS AGO there was a lot of talk about a future world in which people would live by pushing buttons. It's nearly here already in the modern power plant. Button pushing has replaced ninety per cent of the heavy operating labor in the modern power installation. Maintenance and repair still utilize brawn, but even here proper schedules and proper operating methods cut down the heavy work. An example is scientific feed-water softening and boiler-water conditioning, which practically eliminate the cleaning and replacement of boiler tubes.

About the only operating requirement today is brains. It is a good thing, pointing to the complete enfranchisement of the competent engineer.

SMOKE IN THE AIR

FROM CHICAGO the editor received a first-class "sock in the jaw" for his May foreword, "Long Row to Hoe," which was construed in part as an attack on the use of C.W.A. funds to conduct a pure-air campaign in that city.

Actually *Power* approves this expenditure under existing conditions; nor did the editorial state otherwise. It *was* worth while to put the engineers to work, and they deserve all praise for their devoted efforts to clean up Chicago's air. The point of the editorial was that smoke campaigns do not and can not get at the root of the dirty-air problem. That requires—before all else—further technical development. More general recognition of that fact will center effort and expenditure where it will produce the quickest and most permanent results.

GRADS IN JULY

JULY FINDS another flock of college grads out on their own. Not as bad as last year, but plenty hard to find jobs even today! As likely as not, they find the door momentarily closed to the "chosen profession"—particularly if it be engineering. To these young men we say that a youthful year spent intelligently in almost any other field of work is no time lost in an engineering career. Broad-gage engineers travel further in the long run. Within reason, variety of work is broadening.

HOME AGAIN

WITH THE PASSING of the old N.E.L.A. and many of its technical committees, the power industry lost an outstanding source of dollar-saving information on plant operation. These committees were unusual in the experience of their members and the practical importance of their common problems. Lack of business competition among members permitted the freest exchange of information, and all profited in lower power costs. Such frank and competent practical information was available from no other source.

Nothing could replace these old committees—certainly not the founder engineering societies with their wide range of interests, often conflicting. Operating needs were best served by the organized talents of the best operating men. Singleness of purpose counts in such matters.

So great was the "will to live" of these groups that some still functioned through unofficial reunions devoted mainly to hard work—for example, the recent session of the N.E.L.A. Hydraulic Power Committee at the plants of the Pennsylvania Water & Power Company and the Safe Harbor Water Power Corporation. (See pages 380 and 418.) Here was a truly remarkable demonstration of the will to give and get practical information through first-hand contact with the right men, machines and organizations. Such things deserve to live.

Commencing July first, five engineering committees have been officially sanctioned by the Edison Electric Institute. These are: Electrical Equipment, Transmission and Distribution, Prime Movers, Hydraulic Power, Accident Prevention.

Among these our readers will recognize two old favorites of the N.E.L.A. days, Prime Movers and Hydraulic Power. *Power* congratulates the Edison Electric Institute on its recognition of their value.

POWER STANDS FOR

1. Making power when it should be made
2. Buying power when it should be bought
3. Cheaper power through modern equipment
4. Easier financing of equipment purchases
5. Better use of by-product heat and power
6. Operating methods that save money
7. Less waste in transmission and application
8. Prevention of smoke, within reason

HEATING THE TRIANGLE

By F. P. FAIRCHILD
United Engineers & Constructors, Inc.

Location forced lower stack height, walled in the coal yard, influenced selection of firing method, governed building architecture

IN 1915 extensive plans were prepared under direction of the Supervising Architect's office for a comprehensive central heating system to displace individual heating plants in the buildings of the administrative group. Certain steam tunnels were constructed and piping actually installed. Preliminary plans were prepared for a central steam plant to be located on the Washington Channel. But for several reasons these were abandoned and such piping as had been installed was removed from the tunnels and used elsewhere. One of the causes for the abandonment of the central system at that time was the refusal of the National Fine Arts Commission to permit erection of the type of steam plant proposed in the location selected. Their objection was the disfigurement of the scene by stacks. The architectural scheme in Washington involves a uniform cornice height, with the Washington monument and the Capitol dome alone providing the prominent departures.

In 1930, when the public buildings program began to take form, the problem of supplying heat for the tremendous additional building volume brought the subject up anew. A resurvey of the whole heating and steam power problem was made and the system which has recently been put into operation was laid down.

The advantages of a central system for the administrative group such as already existed for the legislative group, comprising the Capitol and Senate and House offices, are twofold—saving of labor and fuel and elimination of nuisance.

Saving of labor and fuel in a modern central heating plant, where supervision is centralized and efficient equipment is provided, is obvious. Small plants existing in old buildings were, moreover, antiquated and ill-suited to efficient operation.

The matter of nuisance may be divided into two parts: 1. Street congestion and dirt due to transportation of coal to and ashes from the buildings. 2. Smoke, cinders and other forms of air pollution.

The chart on page 374 indicates clearly what it means to transport coal to various buildings, were it necessary to maintain separate plants in the old buildings and provide them in the new.

As to air pollution and smoke: Heat produced from fuel in a modern central plant, since it consumes a smaller quantity of coal, emits a smaller amount of products of combustion. In addition, more effective methods of cinder elimination can be provided and a closer watch on conditions maintained.

Fundamental considerations in the preliminary design were: Types of firing, location, architectural considerations.

A consideration of stokers or pulverized fuel for the particular location selected, situated as it is in a group of monumental public buildings, led to the selection of underfeed stokers operating at low burning rates per square foot of grate area as being surer, day in and day out, of maintaining a stack reasonably free of dust than would obtain with pulverized fuel. A perfectly clear stack can be maintained when burning pulverized fuel if electric precipitators are provided, but any outage of the precipitators would result in fine dust which, with low stacks might constitute a temporary nuisance.

Any plant site entirely outside the city, while having the advantage of removing all stack gases or cinders from the public building area, was prohibitive in capital operative costs due to long pipe lines. Only two possible locations existed near the build-

ings to be served where rail facilities for supply of fuel would be satisfactory. The one selected, between 12th and 13th Sts. on the south side of C St., is adjacent to the "14th St. Yard" of the Pennsylvania Railroad, a location just outside the monumental group of public buildings, but near the point of largest load demand. It is convenient for the reception of fuel and disposal of ashes and provides suitable space both for the plant and for coal storage.

Architectural considerations closely circumscribed the design of plant and auxiliary structures. All design was required to meet approval of the National Fine Arts Commission and strict zoning rules of the District of Columbia. The parapet height of the building was set within a fixed limit; height of the stacks was limited to about 135 ft.; and the building was required to conform to the architecture of adjacent structures. It was necessary, for the sake of appearance, to surround the coal storage with an ornamental wall to hide the unsightly coal pile from view and prevent as much as possible the drifting of coal dust.

The boiler plant building is of brick and limestone of a design consistent with the other structures in the district. Stacks are housed in stainless steel enclosures, and are not visible except at a considerable distance from the plant.

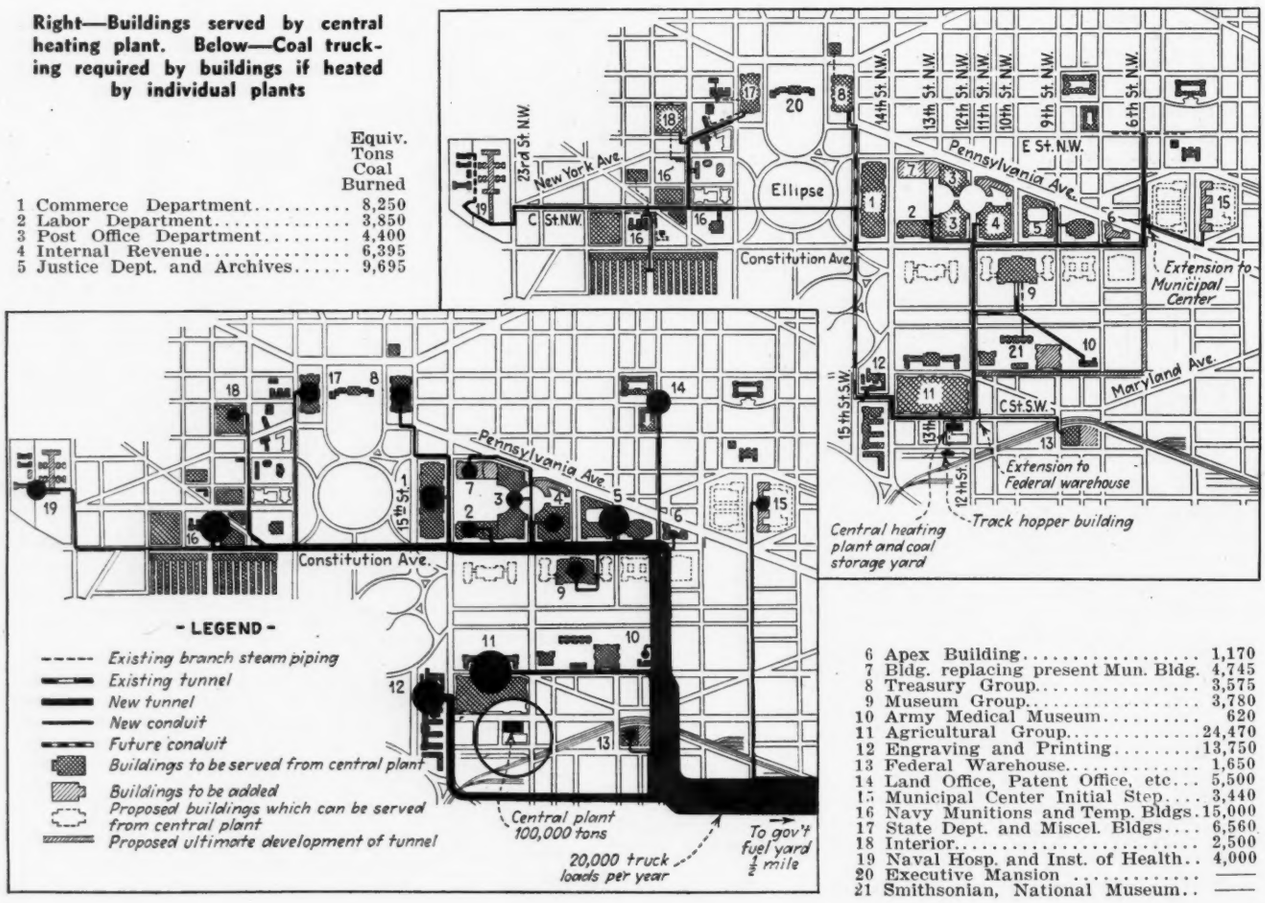
As originally contemplated, the initial maximum steam demand on the plant was to be 615,000 lb. per hr., which would increase to 851,000 lb. per hr. when other buildings included in the ultimate scope were added. To supply this demand, boilers with approximately 25,000 sq.ft. of heating surface were chosen. The first step, contemplating a maximum demand of 615,000 lb. of steam per hr., required three such boilers in operation plus one spare. One future boiler would take care of the expected ultimate demand of 851,000 lb. per hr. Based upon these considerations, the plant was designed to house six boilers, five for the ultimate demand including one spare, plus one additional which would be necessary as the development of the district progressed. Before construction of the plant was well under way it was decided to include the load of additional buildings for which a separate plant had previously been planned, making it necessary to install all six boilers at once.

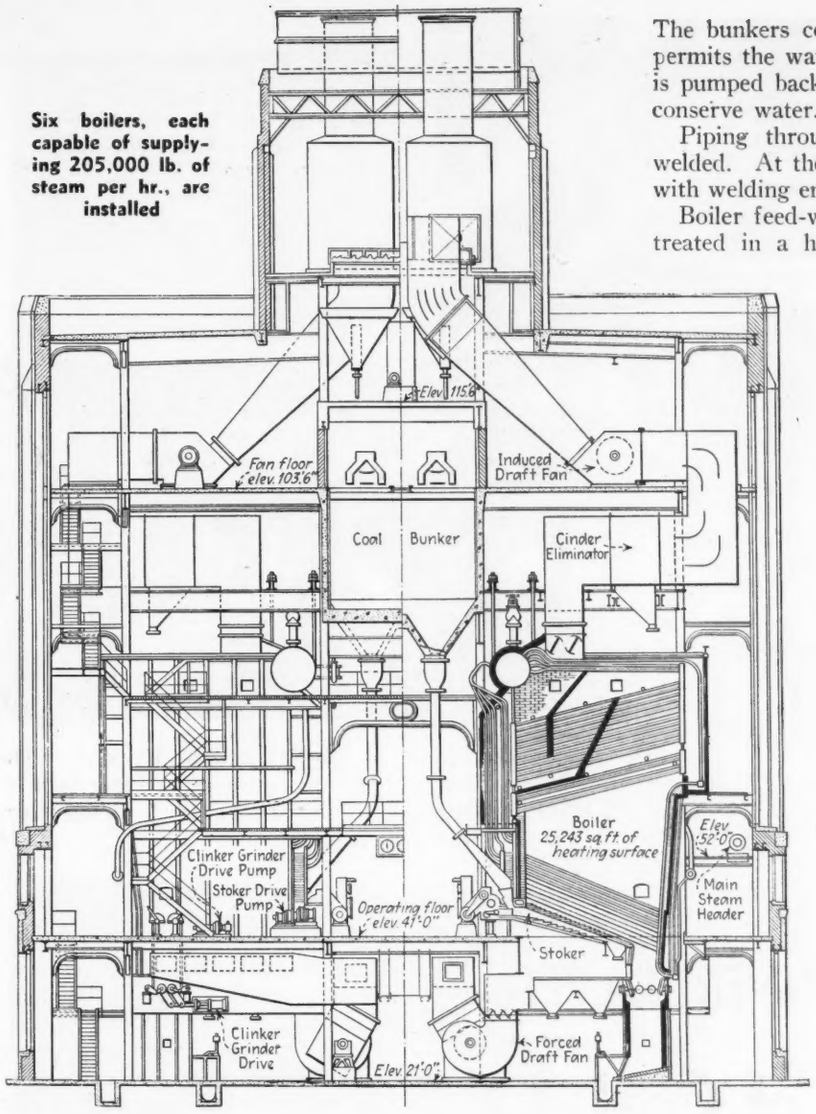
Coal is conveyed to the plant direct from railroad cars by a belt conveyor in a tunnel passing under D St. and the coal storage area. Ashes are removed from the plant by a hydraulic sluicing system which delivers to ash bunkers over the railroad siding. The sluice passes through the coal-handling tunnel. Side spouts are provided on the ash bunkers so the ashes may be delivered to motor trucks when desired.

Coal handling is arranged so that coal may be delivered directly to bunkers within the building or to the storage space by a conveyor, whence it is distributed by a traveling crane and clam-shell bucket. Coal is reclaimed from the storage yard by the traveling crane bucket which delivers it to a belt conveyor beneath the floor along one side of the storage space. A breaker at the delivery ends of the railroad and reclaiming conveyors crushes the coal before delivery to the bunkers. A double skip hoist delivers to belt conveyors which distribute coal to overhead bunkers.

Right—Buildings served by central heating plant. Below—Coal trucking required by buildings if heated by individual plants

		Equiv. Tons Coal Burned
1	Commerce Department	8,250
2	Labor Department	3,850
3	Post Office Department	4,400
4	Internal Revenue	6,395
5	Justice Dept. and Archives	9,695
6	Apex Building	1,170
7	Bldg. replacing present Mun. Bldg.	4,745
8	Treasury Group	3,575
9	Museum Group	3,780
10	Army Medical Museum	620
11	Agricultural Group	24,470
12	Engraving and Printing	13,750
13	Federal Warehouse	1,650
14	Land Office, Patent Office, etc.	5,500
15	Municipal Center Initial Step	3,440
16	Navy Munitions and Temp. Bldgs.	15,000
17	State Dept. and Miscel. Bldgs.	6,560
18	Interior	2,500
19	Naval Hosp. and Inst. of Health	4,000
20	Executive Mansion	——
21	Smithsonian, National Museum	——





Six boilers, each capable of supplying 205,000 lb. of steam per hr., are installed

Boilers are cross-drum, inclined, straight-tube, sectional header type, each containing 25,243 sq.ft. of heating surface. They are designed for a maximum working pressure of 400 lb. per sq.in. gage. For the time being, they will be operated at 200 lb. per sq.in. Water walls are provided for the lower part of the side and all of the rear walls of the furnace. The side walls above the water-cooled section are air-cooled, and air for combustion is drawn down through them by the forced-draft fans. The front walls, for about 20 in. above the stoker caps, consist of silicon-carbide ventilated brick. The front walls above the special sections are air-cooled by natural draft circulation.

Underfeed stokers, 15 retorts wide and the equivalent of 45 tuyeres long, are provided with hydraulic drive and double-roll clinker grinders. Hydraulic stoker drives are operated by oil under pressure from a turbine-driven pump.

Ashes are discharged by the clinker grinders into hoppers beneath the boilers. They are sluiced from the hoppers to an ash sump pit in the boiler house basement, through a grinder which reduces them to a size suitable for handling by ash pumps. These pumps draw from the sump pit and deliver to an 8-in. pipe in the coal conveyor tunnel leading to the ash bunkers. The bunkers contain a separating arrangement which permits the water to run off to a sump from which it is pumped back to the boiler house sluicing system to conserve water.

Piping throughout the plant except at valves, is welded. At the time specifications were issued, valves with welding ends had not yet been developed.

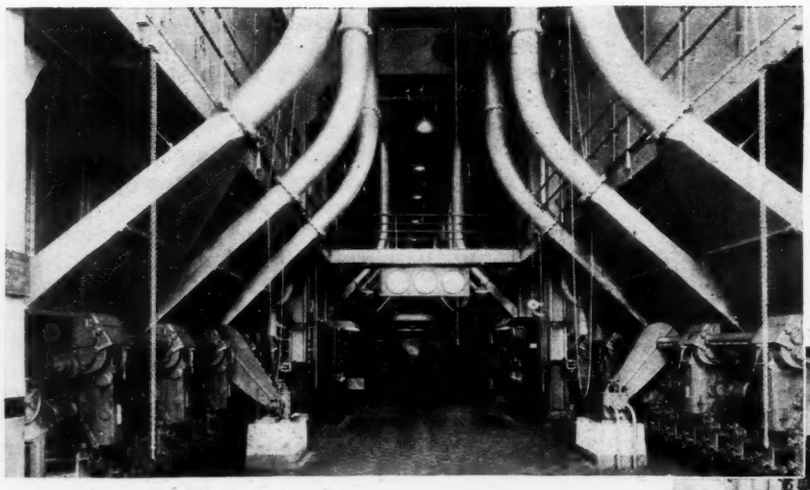
Boiler feed-water make-up is taken from city mains, treated in a hot-process system and passed through filters to a deaerating heater. Returns from the heating system are delivered directly to the deaerating heater. A regulated supplementary phosphate treatment is introduced at the boiler feed-pump suction. Each boiler is provided with a boiler-feed Venturi meter, steam-flow-air-flow meter, flue-gas temperature recorder, water-level recorder, smoke recorder and multi-point draft gage.

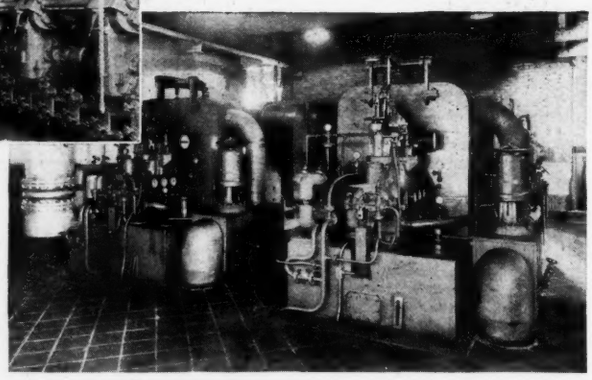
Station auxiliaries are partly motor and partly steam-driven. Motor-driven auxiliaries include induced-draft fans, one boiler-feed pump, coal-handling system and miscellaneous pumps and small equipment. Turbine-driven equipment includes forced-draft fans, two boiler-feed pumps, stoker and clinker grinder hydraulic pumps, service pumps, condensate pumps and two 1,000-kw. house generators. All electrical equipment is supplied from the house generators except the motor-driven boiler feed pump, sump pump, elevator, combustion control compressors, station lighting and electrical clocks, which may be supplied either by the house generators or the Potomac Electric Power Company's feeder. By a suitable distribution of these loads between the two sources of power, an approximate balance at all loads is maintained so that no exhaust steam is wasted to the atmosphere.

A pneumatic combustion-control system regulates stoker speed, forced- and induced-draft fan speed and forced-draft fan discharge damper position from steam-pressure variation. The uptake damper position is controlled to maintain a fixed furnace draft. The system is arranged so that all boilers will operate together automatically or one or more boilers may be placed on base load, the others taking the load swings. Any or all of the boilers may be placed under manual control.

Each induced-draft fan is provided with two motors, one variable-speed, slip-ring, 60-hp., 173- to 345-r.p.m. and one constant-speed, squirrel-cage, 580-r.p.m. The control system is arranged so that, on increasing load, the small motor will increase in speed up to its maximum of 345 r.p.m. When this point is reached the small motor is disconnected and the large motor energized. The uptake damper takes care of the variations in draft requirement between the large motor speed and maximum speed on the small motor. On a decreasing load, energizing of the small motor after the large one has been cut off is retarded until the fan has decelerated to the small-motor maximum speed.

Each boiler uptake is provided with a cinder trap





Left—House turbines may be seen at end of main firing aisle. Below—Two 1,000-kw. turbines supply power for auxiliaries

designed to remove the major portion of all solid matter in the flue gas that passes through it. Space is provided at the base of the steel stacks for the installation of gas scrubbers or precipitators should this be necessary.

Construction cost of the boiler plant, exclusive of distribution system, was approximately $2,200,000.

Operation started in January of this year, the first fire being lighted Jan. 17 and steam delivered to the buildings Jan. 25.

Work on this plant was directed by the Office of the Supervising Architect, now the Procurement Division, Public Works Branch, Treasury Department, N. S. Thompson, chief of the Mechanical Division. The plant was designed and the construction supervised by United Engineers & Constructors, Inc., Philadelphia. Paul Cret was consulting architect.

A CHICKEN DINNER SAVED

500 Tons of Coal

By R. J. WILLIAMS

Engineer, Michigan State Administrative Board

MICHIGAN'S drive for economy in the power plants of 22 state institutions resulted in a saving of $60,500 last year. It is being continued, for so far only the surface has been scratched.

The State Reformatory at Ionia, Mich., will serve as a good example. Some 28.8 per cent less coal was used there last December than was used the same month of 1932. This improved operation meant a saving of 505.6 tons of coal, obtained without expenditure for new equipment. Cooperation from all engineering departments played an important part, and was stimulated by the promise of a chicken dinner if they saved 400 tons of coal—they beat the bogey by 105 tons.

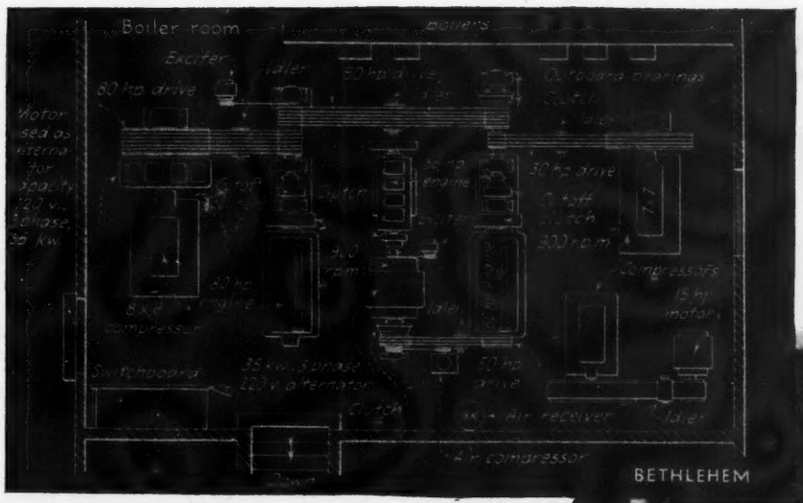
A survey of the heating system at this institution showed that 166 traps were leaking. These were fixed, and return lines were taken down and inspected. Many of them were found heavily coated with lime scale. These were cleaned and replaced. Several small outlying buildings which had been dumping heating-system condensate into the sewer were tied in with return lines.

It was found that throughout the prison cell blocks prisoners were leaving their windows open because of overheating. This was remedied by watching the temperature carefully and controlling steam to radiators by hand.

Boilers are now kept clean by proper use of zeolite softeners and the settings have been repaired. Infiltration of air through the furnace walls was stopped by painting them with plastic boiler cement.

Although practically the same coal has been used and the same firemen employed, evaporation in the boiler room has been improved by daily posting the evaporation for each shift. Shift engineers are rotated every two weeks so that each engineer has the same amount of time on each of the three shifts. The engineer having the best record for the month gets an extra day off.

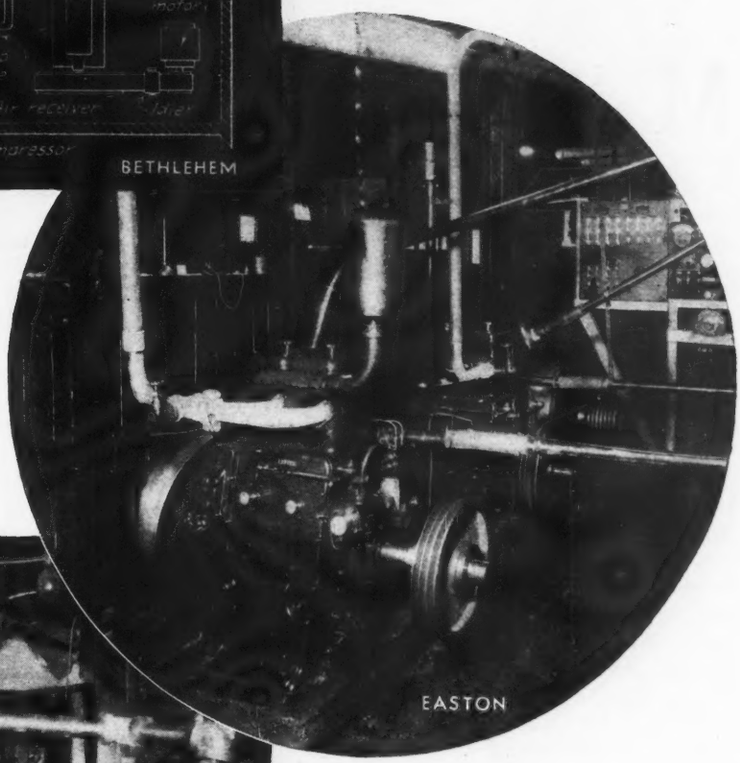
Oil used in the industry and Institution has been decreased 39.5 per cent by careful usage and by reclaiming cylinder oil and using it for institutional purposes. Power used in the Institution has been decreased by 25 per cent by carefully watching the lights and decreasing the wattage on the bulbs wherever it was thought advisable. However, in December the industrial section used 32.1 per cent more power.



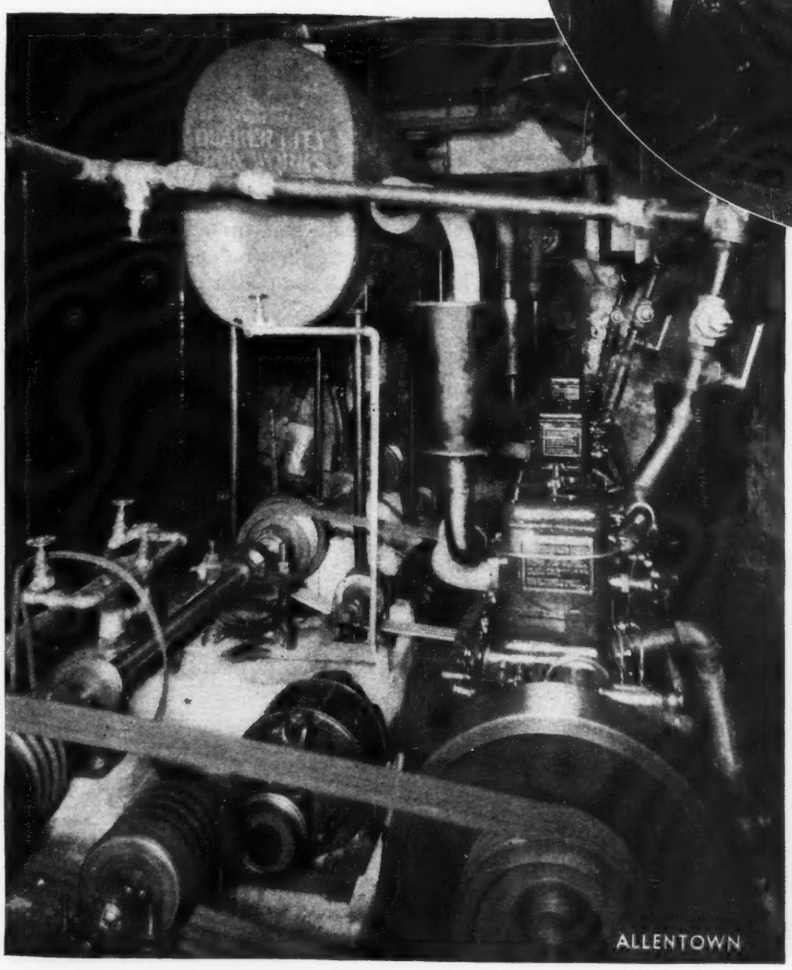
BETHLEHEM

FLEXIBILITY

WITH DIESELS



EASTON



ALLENTOWN

AVONDALE Farms Dairy Co. has obtained unusual flexibility in small-diesel plants for its stores at Bethlehem, Easton, and Allentown, Pa. At Bethlehem, either of two 80-hp. diesels drives an alternator and an 8 x 8-in. or 7 x 7-in. compressor. One 38-hp. diesel is clutched to a 35-kw. alternator which also has shaft and pulley to permit drive from one 80-hp. engine. At Easton, either a 9-hp., an 18-hp. or both may be V-belted to a generator, depending on load. At Allentown, three 18-hp. are V-belted to a single lineshaft with an alternator at each end and two small generators along it.

Photographs courtesy
Peet & Powers

MORE BY-PRODUCT POWER
WITH HOT-WATER HEATING

By NORRIS D. GOVE
Westinghouse Elec. & Mfg. Co.

MUCH plant and process heating is now done with exhaust steam at pressures of 1 to 10 lb. per sq.in. The by-product power generated is in many cases sufficient to meet all plant requirements. Such plants are fortunate, for this power is the cheapest obtainable from fuel and the plant is relatively simple and inexpensive.

Other plants can generate only a portion of their power as a by-product, hence must buy the balance or generate it in condensing turbines. Since condensing power takes from two to five times as much fuel as by-product power, such plants will greatly benefit from anything that will increase the amount of by-product power. For a limited number of these plants the answer is hot-water heating.

Not all processes require heat at 212 deg. F. or higher) nor is it necessary to use steam at corresponding temperatures in all heating systems. When heat can be used at a lower head, the turbine can be exhausted into a water heater under a partial vacuum and the resulting hot water circulated through the plant. The following examples will give an idea of the possible increase in by-product power and assist in making other comparisons.

First let us assume a plant with heating demands that can be met with 50,000 lb. of steam an hour at 5 lb. per sq.in., and with the condensate returned at 212 deg. Total heat given to the plant is 50,000 × (1155.5 — 180) = 48,775,000 B.t.u. per hr. Boilers deliver steam to a non-condensing turbine at 200 lb. per sq.in. and 100 deg. superheat. The turbine and generator have an over-all efficiency of 70 per cent, and the average internal stage efficiency is 75 per cent (mechanical and generator losses taken at 6.7 per cent to give even figures). With this turbine efficiency the quality of the exhaust steam would be 96 per cent and, on account of its lower heat content, 52,026 lb. per hr. would be required by the process. This amount of steam would develop 2,030 kw. with a turbine B.t.u. rate of 3,660 B.t.u. per kw. $\left(\frac{3{,}412}{100 - 6.7} = 3{,}660\right)$. This is excellent from all points of view, but suppose more power is needed. Then hot-water heating may be considered.

In this example, heat requirements, boiler pressure and the turbine efficiency are the same as before. In addition assume that the heating requirements can be met with the same amount of heat (48,775,000 B.t.u. per hr.) at a lower temperature and that the added by-product power recovery will justify a more expensive radiation system. Let us assume that conditions are so advantageous that the plant can be heated with water at an upper temperature of 160 deg. and a lower temperature of 100 deg. The amount of water that must be heated and circulated is 815,635 lb. per hr. or 1,630 g.p.m. $\left(\frac{48{,}775{,}000}{127.8 - 68} = 815{,}635\right)$. If this water is heated by exhaust steam in a surface heater, the turbine exhaust pressure may be reduced to 5.7 lb. per sq.in. abs. This increases the power developed to 2,900 kw.—an increase of 43 per cent. A simple hookup is shown in Fig. 1. In addition, the turbine condensate may be passed through a heater and warmed by steam extracted from the turbine. Power developed by this bled steam will far more than offset the power used to circulate the hot water around the plant, so that the

Fig. 1—Schematic diagram of single-stage heating

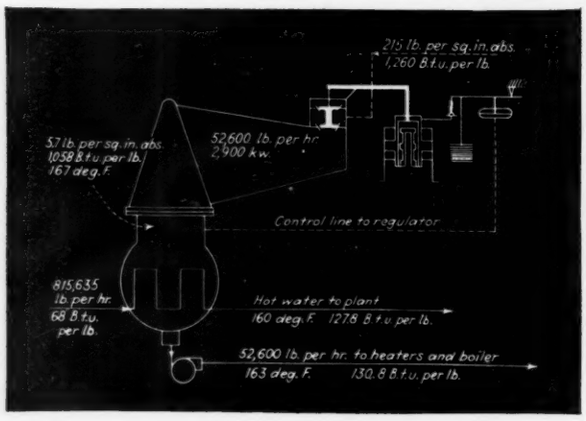
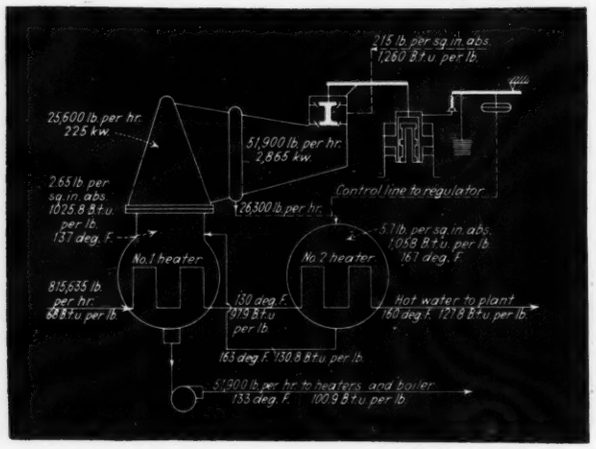

215 lb. per sq.in. abs.
1,260 B.t.u. per lb.
57 lb. per sq.in. abs.
1058 B.t.u. per lb.
167 deg. F.
52,600 lb. per hr.
2,900 kw.
Control line to regulator
815,635
lb. per hr.
68 B.t.u.
per lb.
Hot water to plant
160 deg. F. 127.8 B.t.u. per lb.
52,600 lb. per hr. to heaters and boiler
163 deg. F. 130.8 B.t.u. per lb.

Fig. 2—Schematic diagram of two-stage heating



net increase in power is more than 870 kw. and is developed at a heat cost slightly over 3,660 B.t.u. per. kw.-hr.

With a by-product power unit of this type, a back-pressure regulator would be used. This would automatically govern the load carried in accordance with the heating requirements. The regulator could also be set at different pressures if hotter or cooler water should be needed. A reducing valve would by-pass steam direct to the heater at times of low power load.

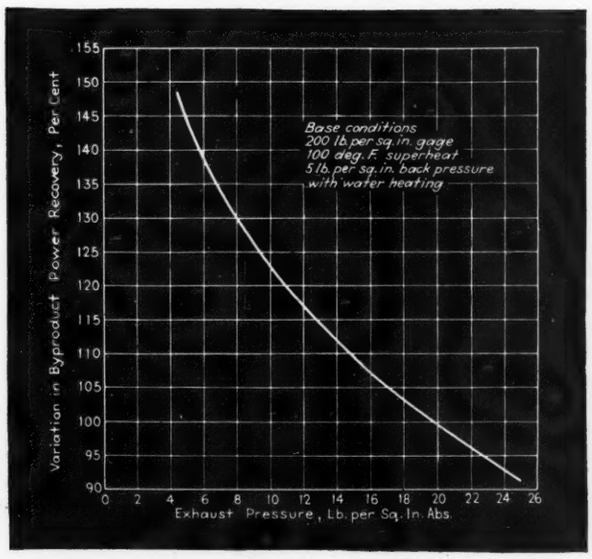
Still more by-product power can be obtained by heating the circulating water in two stages. Fig. 2 shows the diagrammatic arrangement on the same basis as Fig. 1. The net added load developed by expanding practically half the steam to a much lower pressure is 190 kw., or 1060 kw. more than was generated when heating with exhaust steam direct.

So far only surface heaters have been considered. It is equally possible to use the cheaper jet condensers as heaters. An objection to this in many plants is that the pure condensate is mixed with the circulating water so that raw water must be supplied for boiler feed.

Fig. 3 shows in curve form the benefits resulting from reducing the back-pressure of a turbine operating under steam conditions of 200 lb. per sq.in., 100 deg. superheat. The base back-pressure is taken at 5 lb. per sq.in. gage, with condensate taken out of the heater at 223 deg. The curve will not apply to other throttle conditions, since with higher throttle pressure the benefits (expressed in per cent) are less, while with lower inlet pressures the improvement is greater.

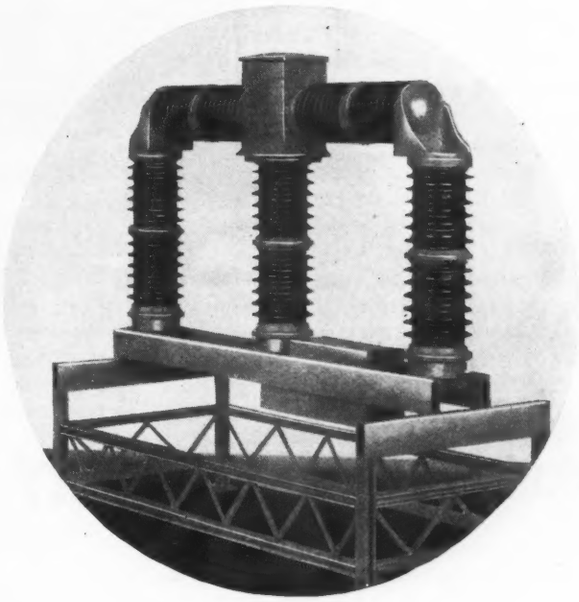
The favorable aspects of hot-water heating from the viewpoint of increased by-product power have been shown. The other side of the question, that of increased plant cost, must be answered for each particular case by the man who contemplates such an installation. Heaters and pumps add somewhat to the total cost, although probably not to the cost per kilowatt. The complication is somewhat greater. In a straight plant-heating proposition the amount of radiation surface must be greatly increased, although for dye works and certain chemical plants using large quantities of warm water, the arrangement seems perfectly feasible, and is in fact in use in one of the larger carpet factories.

Fig. 3—Per cent increase of by-product power with reduced back pressures



FOR BOULDER DAM—

World's Largest Circuit Breakers

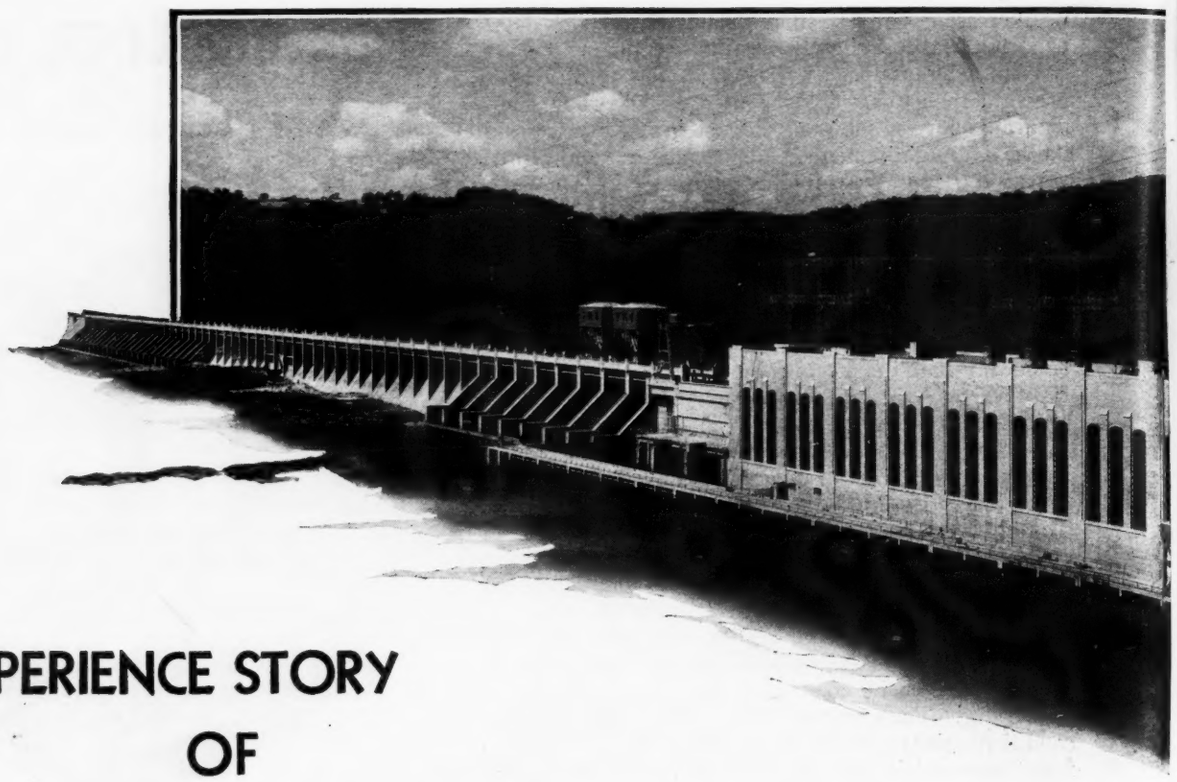


THE 287,500-volt transmission lines from Boulder Dam to Los Angeles will be protected by eight superspeed impulse oil circuit breakers, according to the City of Los Angeles Department of Water and Power. The breakers will be unusual in several respects: They will be used at a higher voltage than any others; they are rated to interrupt the circuit in slightly more than one-third the time of the fastest breakers heretofore available for high voltages; the complete units will weigh less than the oil alone now required for breakers of the conventional design; and they will require less than five per cent as much oil as would usual breakers for such voltage.

These new breakers will have an interrupting rating of 2,500,000 kva. and will have a rated opening of three cycles, or 0.05 sec.; the fastest heretofore available for high voltages have been rated eight cycles. These will require approximately 1,000 gal. of oil each. If built with conventional tank design, 23,000 gal. of oil would be required for 287,500-volt service.

The impulse principle has proved highly successful in electric railway work at 11,000 volts, and a series of tests has proved it will be efficient for high-voltage service. In impulse breakers a piston drives streams of oil into the arc paths when the contacts separate, giving a very rapid and positive interruption of the circuit.

The new breakers, built by General Electric, will be novel in appearance in that, instead of the usual large tank with two bushings projecting through the cover, each pole unit resembles the letter "E" turned on its side. Conductors will connect to the ends of the horizontal member, which contains eight sets of contacts in series. The oil piston is in the box at the top of the center vertical post. A motor-wound spring-operating mechanism is in the housing at the foot of this post.



AN EXPERIENCE STORY OF SAFE HARBOR PLANT—I

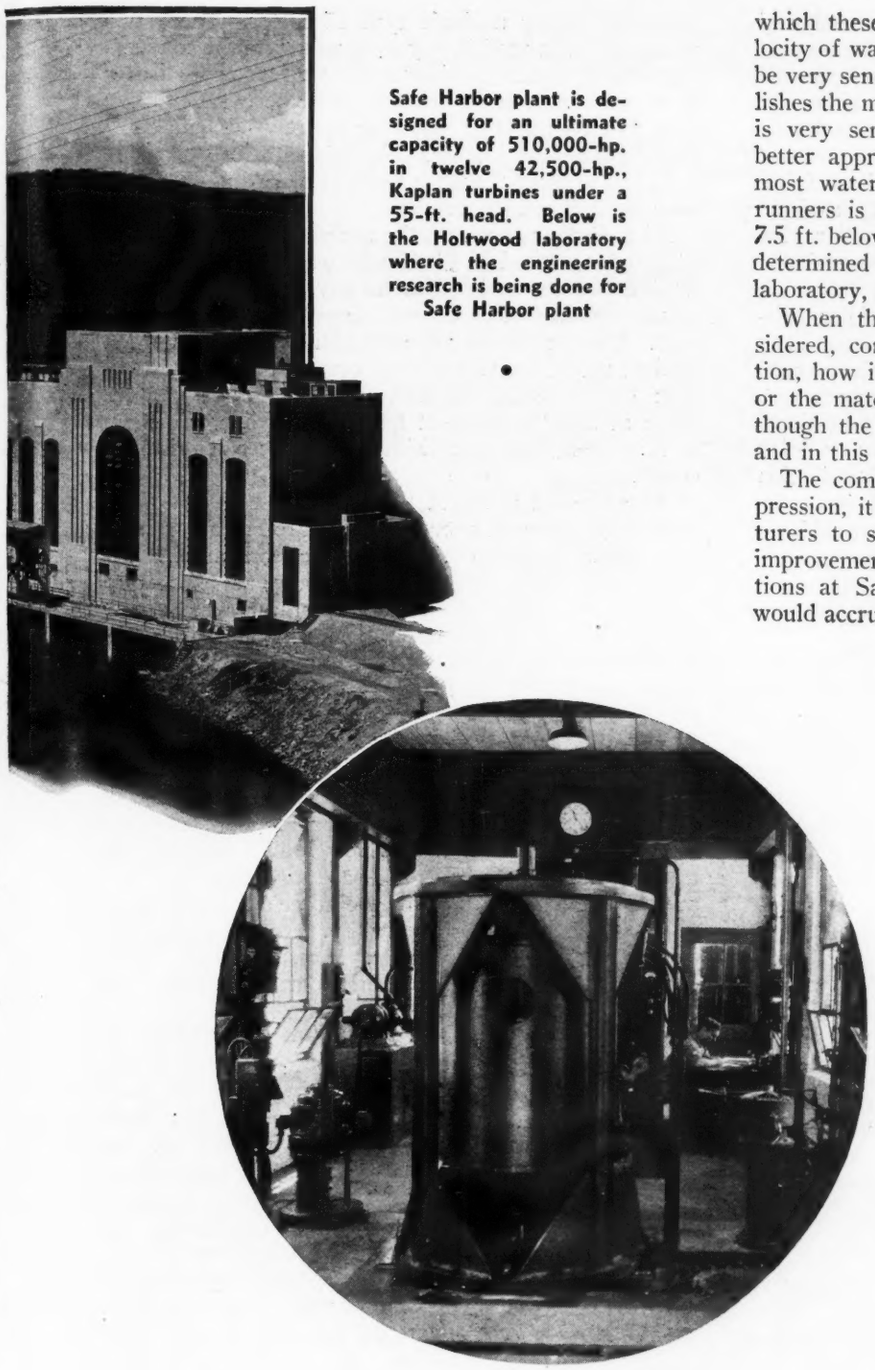
By F. A. Annett
Associate Editor

Any power plant presents difficulties, but a plant with triple-size units and great advances in practice faces multiplied ones. Here they were overcome by study and courageous research

SAFE HARBOR PLANT, since its construction was started in 1930, has been a Mecca for engineers interested in hydro-electric practices. It has been a feature of many engineering society meetings—the latest a reunion of the old hydraulic power committee of the former National Electric Light Association on Sunday, May 27, as part of a three-day program. I attended this meeting and also have had the good fortune to visit this plant on other occasions.

While attending this last meeting the thought occurred to me that there was an intensely interesting story about Safe Harbor that had never been told—a story that should be told not only for its engineering interest but also for the light it throws upon the problems which have to be met in designing and operating a large and modern hydro-electric plant. An outstanding feature of this development is the experimentation and research that has been associated with the work. It started long before the initiation of Safe Harbor design and is still in progress. It should not be presupposed that this research is an indication of difficulties as to efficiency, operating characteristics, reliability, or durability of the hydro-electric equipment. Only by such experimental and research work may the best relation be established between reduced cost of development, higher sustained efficiency, greater service reliability and lower over-all maintenance.

Research is no stranger to executives and engineers of the Pennsylvania Water and Power Co. They have had long and successful experience in design and operation of its Holtwood plant, where many modern ideas regarding hydro-operating practices and economics have been developed. This work has proved that an engineering research department, properly organized and directed, is one of a company's most valued assests, which it is desirable to maintain on a permanent basis. This has been done even at the cost of considerable sacrifice during periods of financial stress, not only to get the utmost in effectiveness during such periods, but to prepare for the better business times to come. It is only natural then that the company built a research laboratory when it decided to go ahead with Safe Harbor, which because of the equipment to be installed involved many problems on which complete information was not available. This laboratory has paid its way several times in providing fundamental data necessary for proper design and operating procedure.



Safe Harbor plant is designed for an ultimate capacity of 510,000-hp. in twelve 42,500-hp., Kaplan turbines under a 55-ft. head. Below is the Holtwood laboratory where the engineering research is being done for Safe Harbor plant

The capacity of the Kaplan units proposed, 38,500 hp., at the time they were being considered for Safe Harbor, was exceptionally great. However, as the result of experimentation and research, it was found possible to push the rated capacity up to 42,500 hp. per unit. This was more than three times the capacity of any Kaplan turbine in operation in the world and more than eight times that of any of the same type in this country. When design of these wheels was being considered, the first commercial installation of propeller-type turbines of any kind was only about thirteen years old—a very short period of experience in development of any art. For a description of Safe Harbor plant, see last month's *Power*, pages 336 and 337.

Because of the relatively high head and speed at which these wheels were to operate and the high velocity of water through them, it was realized they would be very sensitive to cavitation. In fact, cavitation establishes the maximum load that such a unit can carry and is very sensitive to draft head. The latter will be better appreciated when it is stated that whereas, in most water-power installations, the centerline of the runners is above tailwater level, at Safe Harbor it is 7.5 ft. below normal tailwater level. This position was determined only after exhaustive tests in the Holtwood laboratory, thus avoiding possible operating difficulties.

When the design of Safe Harbor was being considered, comparatively little was known about cavitation, how it was produced, how it could be controlled or the material that would best resist its action, even though the problem had been studied both in Europe and in this country.

The company felt that, because of the business depression, it could not expect the waterwheel manufacturers to stand all the expense necessary to develop improvements in turbine design for the exacting conditions at Safe Harbor, particularly since the benefits would accrue largely to the power company. The company cooperated in tests and research, initiated many of these, and the waterwheel manufacturers made certain investigations of their own.

A laboratory like that at Shawinigan Falls, Canada, would have been suitable for model tests of the Safe-Harbor turbines. This laboratory, however, was then very busy. There was no other hydraulic laboratory in which a model of Safe-Harbor plant could be tested under full head, 55 ft., and where the headwater and tailwater levels could be varied through the ranges desired for study of cavitation and other effects. The laboratory which the company built at its Holtwood plant provides for testing model runners 16 in. in diameter under heads up to 70 ft. Every provision has been made for studying the flow of water through the runner from ideal operation to the worst cavitation conditions and for accurate tests through a wide range of load and speed.

In addition to this work, the company sponsored fundamental research in a cavitation laboratory at Massachusetts Institute of Technology, supplemented by special work done at Karlsruhe Institute of Technology, Germany, under the direction of Prof. Wilhelm Spannhake. Recently, at Safe-Harbor plant, a low-head cavitation stand has been installed and put into operation. A high-head cavitation stand has also been installed in the Holtwood steam plant. The water velocity as now used in this stand is 265 ft. per sec., but can be increased above 300 ft. per sec. Accelerated cavitation tests are being made there to determine the resistance of various materials to the destructive action of cavitation. This work is being done in cooperation with other like projects in America and abroad and is in itself a very large undertaking with great economic possibilities.

It is known that stainless steel resists cavitation bet-

ter than most any other known commercial metal, and it has been used in Europe quite extensively for Kaplan turbine-runner blades in the higher-head developments. It is hoped that experiments conducted at Holtwood and Safe Harbor will show that a cheaper steel may be the economical answer to the problem.

Because of the large volume of water (about 9,000 sec.ft. maximum per turbine), the short length of the intakes and their large cross-section, the selection of a method of water measurement is a difficult problem. When penstock conditions are favorable for their use, the Gibson pressure-time method and the Allen salt-velocity method are highly accurate and are accepted as standard in the United States and Canada. The situation at Safe Harbor is unusual and these methods had, at that time, not yet been applied under such conditions.

In Europe current meters have been widely used for measuring flow of water to water wheels; but in this country they have never met with general favor. Although the accuracy of the results obtained abroad have been frequently questioned, the Safe Harbor engineers saw possibilities of developing a technique of using current meters and obtaining a high degree of accuracy with them in the new plant.

As a preliminary to the use of current meters, an extensive study was made of the characteristics of American and European meters. After long study a two-current-meter method was developed. The A.S.M.E. test code at present specifies two types of current meters having opposite characteristics—that is, one that over-registers and one that under-registers. The current-meter studies for Safe Harbor showed that no design that over-registered had a stable and well-defined relation between the amount of over-registration and the angle of inclination to the flow. Because of this condition it was necessary to agree to modification of the code and use two types of current meters, both under-registering in oblique flow by different amounts.

Nine meters of each type are, at different times, mounted on frames in each of the three intakes to one wheel. These frames are arranged so that they can be automatically raised and lowered vertically across the intakes at a constant speed, during which time the revolutions of each meter are recorded automatically. This system has proved highly accurate and has greatly simplified application of current meters to measuring large volumes of water.

In Europe, where tests are made with only one type of meter, a false roof is usually built into the turbine intakes to try and straighten out the flow and prevent error in current-meter registration. At Safe Harbor, tests have been made with and without the false roof. Even with the use of the temporary roof it was found that the flow is not straightened sufficiently for accurate measurement by a single type of meter. Since two meters must be used in any case, and since the converging section obtained without the roof provides better flow conditions, it is believed that more satisfactory tests can be made by omitting entirely all temporary structures in the intakes. Tests have also been made with and without the trash racks in place and no difference observed in the results.

As a further check on the accuracy of the two-current-meter method N. R. Gibson was engaged to make an independent test (without any knowledge of the results obtained with current meter) and render a report. The maximum efficiency obtained by the Gibson method checked within 0.7 per cent of that of the two-type current-meter method. These two tests were made at slightly different heads, and when the effect of this on efficiency is considered, the agreement is even closer.

An extensive series of tests was made in the Holtwood laboratory on a model of a Safe-Harbor runner and setting to determine its characteristics at different speeds and loads. Similar variable-speed tests were repeated on one of the Safe-Harbor units using two other machines as hydraulic dynamometers to load it. The shape of the efficiency curve (maximum efficiency versus speed for a fixed angle of the turbine blades) obtained from these tests checked very closely the laboratory results. The maximum efficiency was found to occur in the prototype at the same value of ϕ (a function of head and speed) as in the model. These tests resulted in the selection of a lower speed for the new 25-cycle, single-phase generator that is now being installed. At this lower speed, efficiency and cavitation characteristics are more favorable than for the speed of the 60-cycle units. This is, as far as I know, the first time such a test and comparison has been made. It certainly leads to increased confidence in the results obtained from tests made with small models.

Extensive tests have been conducted on methods of recording flow of water to the units. Piezometer taps for both the Winter-Kennedy and Peck methods were installed in the scroll cases and guide vanes of the units. This installation has been found to be indispensable. It was used for index tests of efficiency to determine the shape of the cam for relation between blade and gate position of the units. During the current-meter tests they were the standard or parameter by which the tests by the two types of meters were compared. Recently they were used for water measurement for the variable-speed tests described above. Recording and integrating flow meters have now been installed on two units and the use of these as checks on operation has many economic possibilities.

This article will be continued in August number.

Current-meter frame with one type of current meter mounted at the top and another type at the bottom

Means Available for Feeding WATER-STARVED Boiler Tubes

A DEVELOPMENT of unusual interest to power-plant operators, as well as to manufacturers of water-tube boilers, has recently been revealed through the issue of U. S. patent No. 1,940,070. This patent covers a means for directing and controlling the circulation of water through the tubes of a water-tube boiler. The method is already in use in several plants and has eliminated troubles previously encountered because of water stagnation in certain portions of the boilers. Springfield Boiler Co., Springfield, Ill., has been licensed under this patent and is prepared to incorporate it in its new or old boilers.

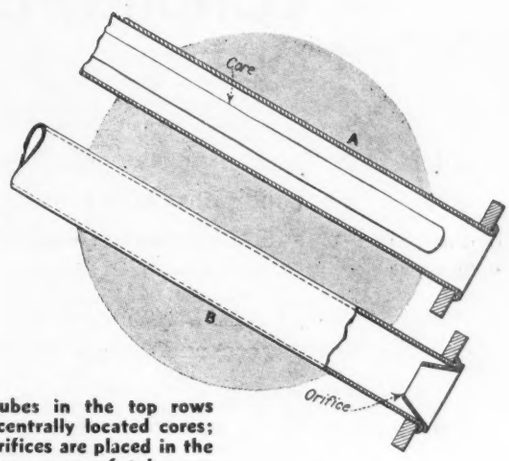
This device consists of properly placed restrictors, or orifices, in certain tubes, and cores positioned centrally in other tubes to properly direct circulation.

Experiences when developing the new system are of interest. Several years ago trouble developed in high-pressure (425-lb.), straight-tube, cross-drum boilers operating at high ratings in a large industrial plant. After about one year of service, a leak was discovered in a tube in the top row of one boiler. This leak occurred on the top side of the tube about 8 in. from its upper end. The tube was removed and showed corrosion inside its upper surface over a well-defined area, such as that occupied by the bubble of an inclined spirit level.

The tube's appearance suggested that a bubble of steam had been pocketed in it, circulation being insufficient to dislodge it. As a result, a portion of the top side of the tube was overheated and the steam attacked it. The most intense corrosion occurred along a line marking the separation of water and stagnant steam, thus giving the tube an appearance of having been grooved along its sides and across the top at its upper end. The leak occurred at a point where the two side grooves met over the top of the tube. An inspection revealed that every tube in the top rows of the boiler proper was in practically the same condition as the leaking one, the intensity of corrosion decreasing as the distance below the top row increased.

A series of experiments showed the primary cause of the trouble to be lack of circulation in the upper rows of tubes. This was readily detected by small pipes introduced into their interiors and opened to the atmosphere. Bluish colored vapor issued from the detector in steam-bound tubes, vapor from tubes filled with water being white.

The tests covered a period of four years. At one stage of the research it seemed that success had been achieved. All detector tubes showed white clouds of vapor. In one boiler a top row of tubes had been replaced by corrosion-resisting tubes, but about one year later one of these tubes ruptured. Inspection showed that the old trouble still existed.



A—Tubes in the top rows have centrally located cores; B—Orifices are placed in the lower rows of tubes

By this time a more sensitive means for detecting steam-bound tubes had been developed in which the same detector tubes were connected to surface condensers and a liquid sample of the tube content obtained. By determining the pH of the samples, the degree of circulation in each tube was indicated. A pH of 11.4, decidedly alkaline, was maintained in the boilers, as indicated by samples of blow-off taken from the lower waterwall headers and from the lower rows of boiler tubes. Samples from the upper two rows of tubes, however, showed a pH of 5.6, distinctly acid. This indicated that the basic trouble was faulty circulation, resulting in steam binding of the upper rows of tubes.

Since no failures occurred in the lower rows of tubes, it was assumed that circulation in these was more than ample. Restrictors, or orifices, were inserted in certain rows of these tubes, as at *B* in the figure, to deflect surplus water into those tubes getting insufficient water.

Because relative low-velocity circulation could be expected, at best, in the upper rows of tubes, it was decided to block out nearly half of the tubes' cross-sectional area, by central cores, as at *A* in the figure. This left an annular space between core and tube wall through which water could flow. As a result, all steam or non-condensable gas was swept out of the tubes and normal alkalinity restored. This indicated uniform circulation, and no further trouble has been experienced with any of the boilers similarly treated.

Since these experiments, the cores and restrictors have been applied successfully to several makes of straight inclined-tube boilers of both cross- and longitudinal-drum types. This system not only eliminates hazard of ruptured tubes, outage of boiler units for repairs, and relieves operators of worry, but it permits boiler rating to be materially increased without distress.

So far experiments have been confined to straight-tube boilers, but will soon be extended to bent-tube boilers, inasmuch as numerous instances of troubles in this type of boiler have been reported. (See NELA Bulletin No. 241 "Boilers, Superheaters, and Economizers," January, 1933).

PURCHASED REFRIGERATION

CONDITIONS SPECIALTY STORE

By PAUL REED

Kline's, St. Louis specialty store for women, air conditions entire store, four floors and basement totalling 40,000 sq.ft., with district refrigeration. Rewards are increased efficiency of sales staff, more and longer visits by customers, cleaner rooms, reduction in mark-downs due to fittings and exposure

FORMIDABLE obstacles had to be faced in air-conditioning Kline's, Inc., large St. Louis specialty store for women. The building was old and the entire interior had recently been redecorated, a thorough remodeling job that cost $100,000. Any plant for conditoning that would have necessitated rearrangements, or disfigured the new interiors, was out of the question. There was only limited basement space available for a central refrigeration plant and equipment, and practically no space in partitions, walls or along floors or ceilings for the large ducts required by a central plant. Finally, cost had to be given careful consideration. Store officials were not interested in partial conditioning, and the cost of complete conditioning of the five floors was roughly estimated at $50,000.

After careful consideration of all factors, a unit system was agreed upon as most practical. Several unit systems were laid out by leading contractors and conditioning dealers. After the contract was let, details of the unit system were worked out in collaboration with E. P. Bradley, consulting engineer.

Final design of the system (or "systems," since there are fifteen complete units) was in the hands of the successful contractor, Sears & Piou, Inc. Sodeman Heat and Power Co. installed the job, and within 30 days of the signing of the contract—a remarkable feat when it is remembered that a condition of the contract was that installation should not interrupt any store activities or inconvenience patrons in any way.

As finally installed, the systems include three shell-and-tube coolers, a 30-hp. pump, fifteen unit conditioners, each with a separate duct system. In several cases, overhead units had to be employed, using space over a doorway. In one instance, the space of an abandoned elevator shaft was utilized for one unit on each floor, and for another the corner of a stock room above the working space. This was done in spite of the fact that all ceilings were only 15 ft. high.

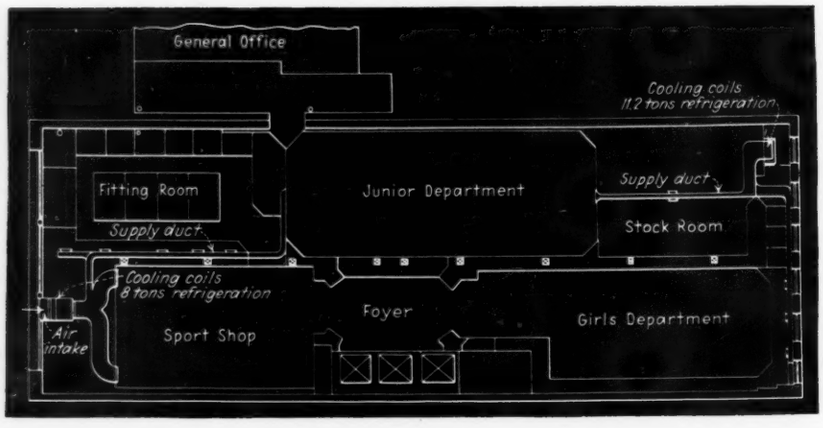
St. Louis has an extensive street pipe-line system circulating ammonia for cold storage and refrigerating purposes. This system now serves numerous applications for comfort cooling, such as restaurants, hotels and other buildings. The fact that one of the ammonia mains runs past Kline's made it practical to give consideration to this source of cooling. Final choice of the pipe line as a refrigeration source was not governed by any one factor of cost, space, service or maintenance, but was based upon a combination of factors which gave the pipe line system most advantage in the rather unusual requirements of this particular design.

The three shell-and-tube coolers were used instead of the usual one for both economy and flexibility. Some space was saved also, as the coolers were installed horizontally in a tier. The pump circulates 450 gal. of an alcohol and water mixture per hour on capacity load. This mixture is used instead of the brine, because it is non-corrosive (permitting copper cooling coils in the conditioners) and because it has a higher specific heat and a lower specific gravity than brine.

All fifteen units are independently operated and are equipped with both hand and thermostatically operated valves. This gives a wide range of flexibility so important where departmental sales or seasonal buying habits fluctuate. One day the basement may be crowded; the next week the Fur Shop or the Misses' Shop may bring in much more than a normal attendance.

Fans installed in the units are driven by motors totaling 17¾ hp. and move 45,000 c.f.m., 10,000 c.f.m. of which is outside air. The ducts are designed for velocities of approximately 1,000 f.p.m. and the slotted face grilles give a much higher veloc-

Unit at right is installed in old elevator shaft. Branch to Junior department from unit at left is blanked off as described in text



ity, because of a high static pressure behind the face of the grille. Outside air connections are made to thirteen of the units, and damper arrangements permit 100 per cent of the air to be brought in from the outside if desired.

Ducts from each unit are zoned. As they were never deeper than 12 in. nor wider than 30 in., they were relatively easy to route inconspicuously. In several places ducts run along the top of wall display cases.

Air ejected through the slots in the grille faces spreads in a thin blanket across the upper part of the rooms, the velocity insuring that the entire space is covered. On the second floor, for instance, the "throw" of cooled air in the Sport Shop is 40 ft., in the Girls' Shop it is 48 ft., and in the Junior Department it is nearly 60 ft. The latter room has a grille at the end opposite the one now operating (which was installed for safety's sake), but during the past season it has not been found necessary to use the second grille.

This method has proved successful in cooling every part of the store, especially the fitting rooms. Groups of fitting rooms are on each floor and each presented a different problem. On the second floor the fitting rooms are shunted between shops or sales rooms and the general office area and have no outside window space. Previously, these fitting rooms had been very uncomfortable during the summer months. Customers were reluctant to come to the store; when they did they were likely to become irritable.

Five outlets along the duct direct the high-velocity cooled air across the fitting rooms near the ceiling. Cooled air drops gently and mixes with the lower warm air. Partitions of fitting rooms do not extend to the ceiling, and cool air freely enters the tops of the stall-like rooms. Fitting rooms have been made thoroughly comfortable, tests showing that not more than a 2-deg. variation in temperature exists in any of the fitting rooms.

The amount of cooling necessary to condition the entire store was estimated at the rate of 140 tons of refrigeration at peak requirement. As a store load is somewhat different in its makeup from any other load of similar size, we might examine it more closely. The store, because of its lack of windows and the unusually well-lighted shops, carries a peak lighting load of 100,000 watts or, in terms of heat load, practically 340,000 B.t.u. per hr. continuously. This is a refrigeration load of approximately 28 tons. The human load, based on a peak occupancy of 1,000 persons in the store at one time, adds 400,000 B.t.u. per hr., or a refrigeration load of 33 tons. The third major factor is that of outside air. Approximately 10,000 c.f.m. of outside air, weighing 740 lb. is circulated per minute. This air, at 95 deg. F. and an average summer relative humidity, will add a heat load of 399,600 B.t.u. per hr., or at the rate of 33 tons of refrigerating effect.

Top—Air to entire 48 ft. long room is supplied through three grilles. Left —cooled, dehumidified air is supplied through duct at top of unit. Water and alcohol mixture enters and leaves through insulated pipe at right

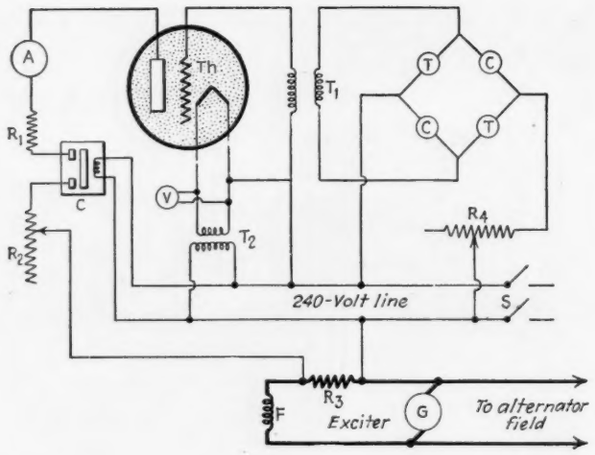
These three factors of lights, people and outside air add a total of 94 tons. The remainder of the 140-ton peak load is taken up by infiltration, wall and ceiling absorption of radiant heat, the opening and closing of doors, mechanical equipment, etc.

An inside temperature of 80 deg. dry bulb and a relative humidity of 50 per cent, when the outside dry-bulb temperature is 95 deg. and the wet bulb is 78 deg., is guaranteed. Actual tests taken throughout the cooling season at many points in the store indicated an average of 77 deg. dry bulb and 46 per cent relative humidity has been continuously maintained. This is an effective temperature of 70 deg. and a wet bulb of 62 deg., practically an ideal atospheric condition for human comfort.

The operating season for design purposes was based on 1,400 hr. This is approximately 150 days at 9 hours daily operation. The actual load was very close to this estimate. Energy consumption for fans and pump was estimated at 30,000 kw.-hr. for a 5-month operating season. The actual consumption was nearly identical with this estimate. The pipe line refrigeration company charges a flat rate for its service. On many days at the beginning and end of the cooling season the demand for refrigeration may be only for one or two hours each day.

Results

The Kline organization is well pleased with these conditioning systems. While they have found it impossible to determine how much, if any, business might be attributed to the system, they did find that the store became and kept much cleaner than before, an official estimating that thousands of dollars will be saved yearly on cleaning alone. The markdowns made necessary from fittings have markedly decreased; the sales staff is more alert; patrons linger longer.



THYRATRON REGULATES VOLTAGE of 90-Kva. Alternator

By G. G. KRETSCHMAR
Physics Department
Walla Walla College, Wash.

DEVELOPMENT of the hot-cathode Thyratron or grid-controlled mercury-arc rectifier has opened up new possibilities for control and regulation of many types of electrical equipment. As in other grid-control electronic devices, a very small charge is sufficient to control a large output in the Thyratron. It may be limited by the external resistance only, and this makes the output single tube sufficient for regulation of heavy equipment.

A voltage regulator for a 90-kva., three-phase, 240-volt alternator by Thyratron control of the exciter-field excitation is here described. Only one phase of the three-phase circuit is regulated, but as the load is approximately balanced this serves to give good regulation for the entire system. The figure gives a circuit diagram of the regulator. The voltage-sensitive element consists of two 16-candle-power, 50-watt, carbon lamps, *C* and two 40-watt tungston Mazda C lamps *T* arranged in opposite legs of a Wheatstone-bridge circuit. The lamps run at less than their normal operating voltage, which makes for longer life and greater reliability.

Two corners of the Wheatstone bridge are connected to the 240-volt line in series with a 140-ohm rheostat R_4 of the tubular slide-wire type. The rheostat serves to set the system voltage and the operating point of the Thyratron. The other two corners of the bridge circuit are connected across the primary of a 1-to-3 ratio audio transformer, T_1, the secondary of which is applied to the grid-filament circuit of the Thyratron.

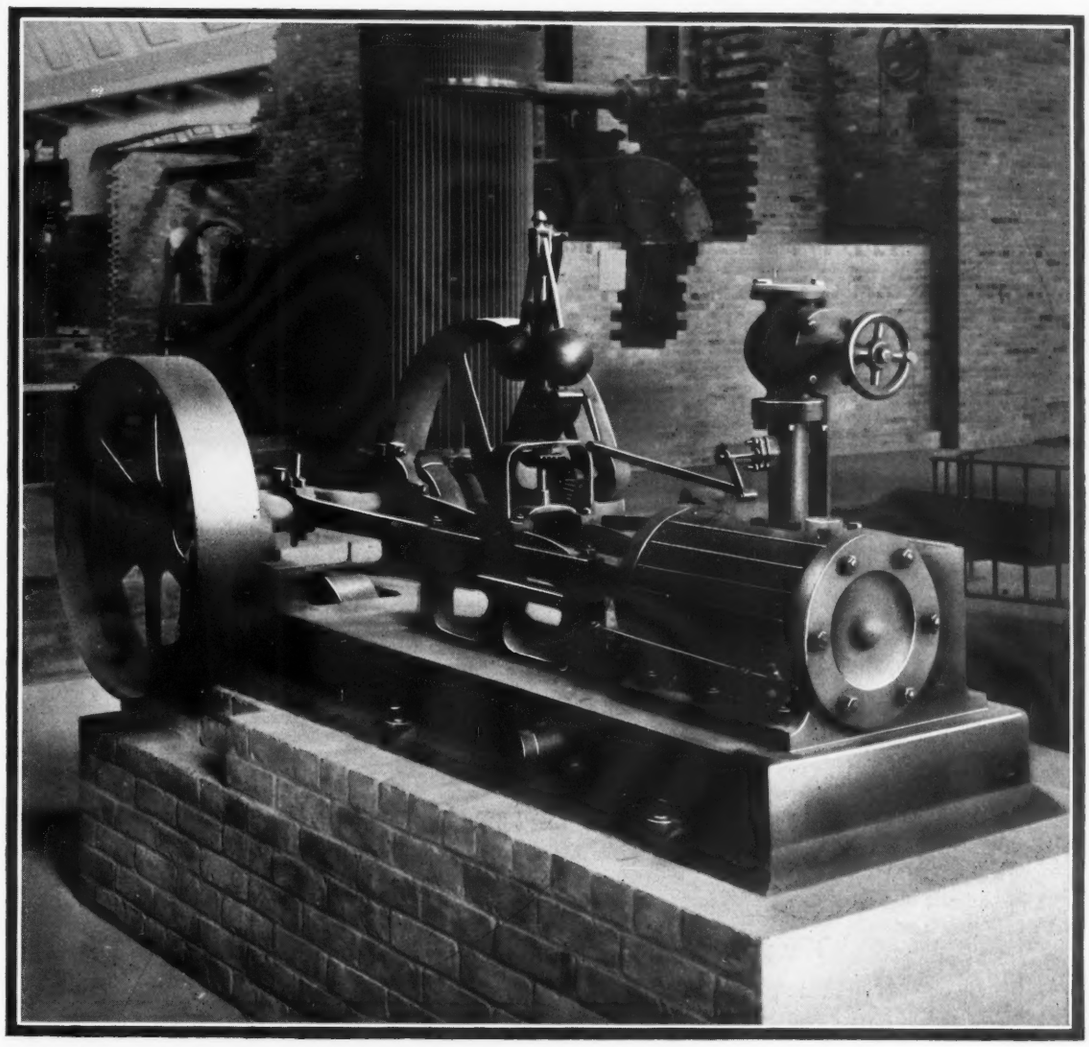
A General Electric FG 57 tube is used, which has an indirectly heated cathode. This tube requires five minutes to heat before going into operation. For this reason a manually operated magnetic cutout *C* is used in the output circuit. This remains open when the switch *S* is closed and is not closed until sufficient time has elapsed for the cathode to heat.

The direct-current output of the Thyratron is applied across the exciter field rheostat R_3, part of it going through R_3 and part taking the path *F-G*, thus raising the output of the exciter and maintaining line voltage. As soon as line voltage is restored, the bridge is balanced and the Thyratron output is reduced to zero. This action is repeated so rapidly that a small current may be observed on the direct-current ammeter *A*. With a short-period ammeter, the needle may be observed to swing as load variations are compensated, but without large or periodic fluctuations, unless hunting occurs.

R_1 is a fixed resistance of about 40 ohms, in the anode circuit, to limit Thyratron output to its maximum rated current, which for Type FG is 2.5 amp. R_2 is a varible rheostat of about 500 ohms placed in the circuit to reduce the tendency to hunt which was encountered at first. It was found, however, that hunting could be controlled by the exciter-field rheostat R_3, the resistance of which is about equal to the exciter field. The equipment will operate without attention throughout the load range of the generator, if R_3 is set so that the Thyratron supplies only a small part of the exciter-field current, the larger part coming from the exciter. It was found convenient to fix R_2 at a value which limits the current to one-half ampere or less, and set R_3 at a value to hold the voltage at about 10 per cent less than normal. The Thyratron boosts the voltage to the required value and operation is satisfactory and reliable.

A type FG-27 tube which has a heating time of only one minute, may be used if desired. Also a time-delay relay might be substituted for the magnetic cutout C, which would make the regulator more serviceable for some conditions. In the present installation the arrangement shown is very satisfactory, since purchased power is used at night and the generator started each morning. A double-row switch is used for changing the load from the generator to the outside power lines, and when this is thrown the cutout automatically disconnects the regulator from the system.

When the operator wishes to start the generator, he first throws switch *S*, so that the tube is warmed up while the generator is brought up to speed. After the main switch is thrown to the generator, the cutout lever is pushed, thus putting the regulator into operation. The cutout also acts as a low-voltage release as it will drop out should a large voltage drop occur.



No. 7—WARWICK HORIZONTAL ENGINE

THIS is an example of the low-pressure horizontal engine in common use about the middle of the 19th Century, when similar small engines were to be found doing duty in a variety of ways all over the world.

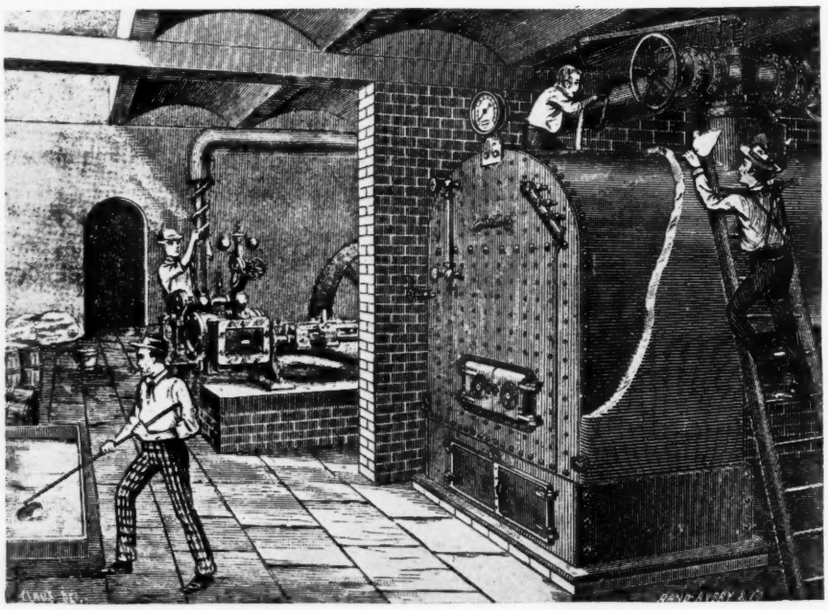
This engine was made about 1860 by Mitton & Ingram of Warwick, England, for the old Warwick Navigations Company, and for many years worked on a "spoon dredger" used to maintain the depth of the Warwick and Birmingham Canal. It has a bore of 7½ in., a stroke of 12 in., and a flywheel 35 in. in diameter. It is a reversing engine and is fitted with the link motion evolved by William Howe in 1842. When Henry Ford visited the Warwick Navigations Pumping Station at Bowyer St., Birmingham, England, in 1928, he saw this engine lying disused in an old smith's shop. He acquired it, and it was brought to America and erected in the Edison Museum in 1931.

The horizontal type of engine was introduced by William Symington of Wanlockhead, Scotland, who, in 1801 fitted it to a steamboat called the Charlotte Dundas, in which it worked with every success. It was slow, however, in attaining popularity and did not become commonly used until about 1840, when the century had become well advanced. It remained, however, one of the most popular types of engines ever made and is still manufactured extensively.

It is a matter of interest to observe that William Symington, who invented this horizontal type of steam engine, did much to develop the early application of steam for marine purposes. As long ago as 1788 he constructed two vessels which were propelled by steam, using double-cylindered atmospheric engines, the first of which is preserved in the South Kensington Science Museum, England.

EDITORS NOTE:—*This is the seventh and last of a series of single-page descriptions, with photographs, of famous old steam engines being set up for display at the Edison Museum, Dearborn, Mich. This Museum is to be used by the Edison Institute, an educational project conceived by Henry Ford to honor Thomas A. Edison.*

STEAM PLANTS THAT MADE HISTORY



Old-time factory power house, 1884

FIFTY YEARS

The past, present and future of power generation, as seen by leading American engineers

The June number marked Power's *Fiftieth Anniversary. Further to commemorate a half-century of progress the editor invited a number of engineers to send him their thoughts on the past, present or future of power generation. Four pages were kept open for the answers, but their volume far exceeded the space provided. Additional letters will therefore be published in the August and September numbers.*

The Far View

• AFTER reading your letter it occurs to me that *Power* might perform a very useful service by concentrating on the future as a sequel to a review of the past. The civilized countries of the world have just passed through a most harrowing experience and we of this country have had our share during the past few years. As is natural under such conditions many people develop a defeatist attitude toward the future and to me it seems that this attitude of mind results in the spreading of despair and pessimism when we really should be enthused with optimism.

I have made it my business to review the history of many of the depressions that the civilizations of this world of ours have known, starting back with the old Mediterranean world and following through to the present time. It is most astounding to discover how, under various forms of civilization and under different types of government, human beings have reacted time after time according to an almost invariable psychological pattern.

When one discovers this he is inclined to wonder whether it is not old *genus homo* himself that is responsible for this and other depressions rather than a leading class or capitalistic system or such other fancied criminal as has been selected from time to time to account for the troubles of the world.

I have been particularly impressed by the commonness of the expedients which have been adopted in each case and particularly by the ancient lineage of many of the features of the so-called "New Deal." One wonders what government, commerce and industry might become if all of us really knew the histories of the peoples of the world.

One of the preachments of despair which we hear now and which we would have heard at many different times in the past had we then been living is to the effect that man has already completed his scientific, inventive and industrial development; that from now on we shall have nothing radically new and potentially big; that the work of the world will remain substantially fixed in quantity and that for these reasons we must allocate among the members of an ever increasing population a substantially constant amount of work. To one who like myself is forced to stand upon the borderland of scientific and industrial developments and to look out into the unknown country beyond in an effort to determine those directions in which further progress can and should be made such preachments are ridiculous in the extreme. I personally know of so many potentially valuable developments that I cannot conceive of any one who knows even a small part of the facts remaining pessimistic for very long.

It happens that I have just returned from a meeting at which were discussed the results of two years of research effort by a comparatively small number of men. I was struck by the astounding fruitfulness of the work and still more by a realization of the tremendous extent of the field that still remains untouched. Lest you think that I become unjustifiably enthused over the results of research without giving due thought to the industrial significance or value thereof let me state that many of the results discussed at this meeting are either already disposed of in a commercial sense or are in the process of such disposition.

I wish that it were in my power to collect in one place the editors of the various publications of this country and to afford them an opportunity to see even that small part of the industrial development of the immediate future which through force of

circumstances is made visible to me. I am satisfied that these men would become the heralds of a new, more plentiful and more worth while era and that we should have left very few who were willing to preach despair themselves or to countenance such preachments by others.

C. F. HIRSHFELD,
Chief, Research Department,
Detroit Edison Company.

Engineers and Their Works

• IN ACCEPTING your very kind invitation to contribute to these engineering reminiscences, on the occasion of *Power's* Fiftieth Anniversary, my strongest impulse is to try to emphasize the marvelous changes which have taken place in our power industry during the two-thirds of your magazine's fifty years of life with which I have had experience.

In 1900 there were no turbo-generators in any of the power stations and the largest engine-driven generators were those at the 66th St. station of the Brooklyn Edison Company, which were 2,850 kw. The first power-house turbine came into being in 1903, a 500-kw. unit at the Newport Lighting Company's plant, Newport, R. I., followed in the same year by a 1,500-kw. size at Hartford. Yet now, thirty years later, we consider that 200,000 kw. is not the limit of size. Roughly, the maximum size of turbo-generators available for power companies has doubled every five years since 1905.

The first turbine of 5,000 kw. installed at Waterside Station of The New York Edison Company, was not as efficient as the vertical cross-compound engines in the same station and suffered worse by comparison with the Interboro vertical-horizontal engines. This turbo-generator took about 20 lb. of steam per kw.-hr. at 175 lb. pressure, whereas 10 years later the efficiency had been increased to 12½ lb. under the same conditions. Now, with the higher pressures and temperatures available to the designer, the equivalent or comparable water rate would be under 9 lb. if run straight condensing. It took a lot of courage to go on with the development, but the space saving was sufficient incentive to speed the pace and leave the old engines at the 1905 mark. It is hard for me to realize that very few of our watch engineers at Hudson Avenue are old enough to have operated reciprocating engines unless they came off the sea.

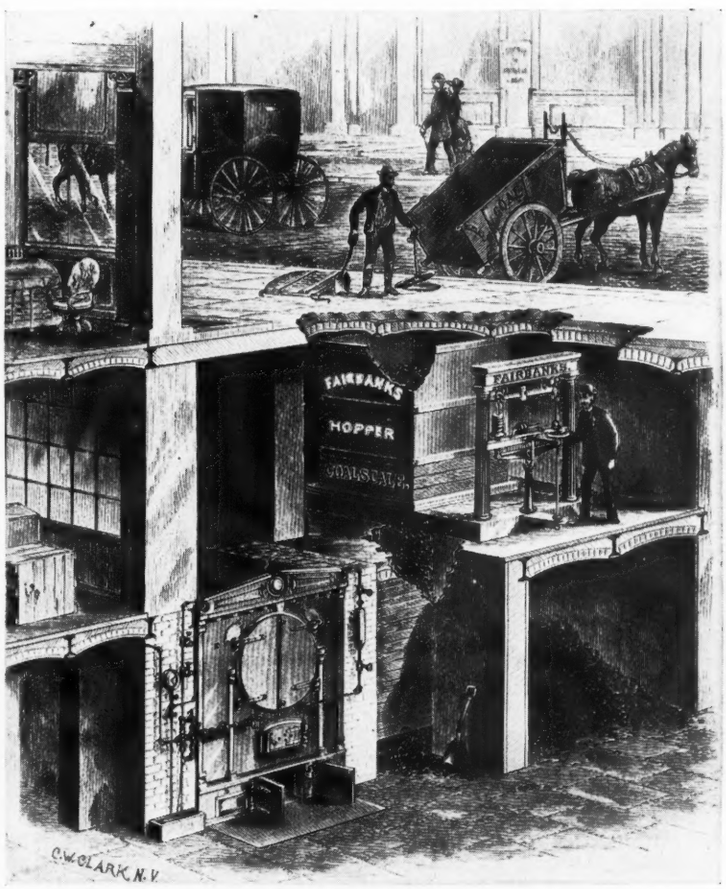
In 1900 one man in the boiler room handled two manually fired boilers and raised 50,000 to 70,000 lb. of steam per hour, and how he did work and sweat doing it at the time of the peak. Now, one man with no physical effort may operate the controls on a boiler generating over 1,000,000 lb. of steam per hour.

I like to think of the men who strove together to make the great development in our power stations what it has been—Barstow, Stott, Sparrow, Murray, Bailey, Anderson, and hosts of others on the engineering staffs of the operating companies, the great engineering corporations and the manufacturers. I pay my tribute particularly to the hard-working and faithful designers in the manufacturing companies, large and small, who have been pushing the art forward all the time. With motives commercial, if you like—that's what makes it all possible—but always with great initiative, ingenuity, ability and pride in their work. Frequently the most cherished reward has been the opportunity to tell about their work before one of the technical societies.

The engineers of the operating companies have had the job of carefully picking and choosing from the offerings of the manufacturing companies major and auxiliary equipment which best fitted their particular needs, always having as the rigid criterion on which they staked their reputations and their jobs, continuously reliable service. The assembly of this equipment into a station completely connected and ready for service at a prearranged necessary date is a task for the experienced only, as those of our industry know, and is rewarded generously by the showing of the completed work in operation to those of the fraternity who understand and criticise.

I am glad to have lived in this period and to have had a small part in this great development. Permit me to congratulate *Power,* its publishers and its editor on the completion of fifty years of splendid service to the Industry and to wish them all many more years of usefulness.

G. L. KNIGHT,
Vice-President,
Brooklyn Edison Co.



Fairbanks hopper coal scale, 1885

Twenty-Seven Years Ago

• I RECALL distinctly one very interesting experience: A large hydro-electric plant had just been completed and put into successful operation. It was an outstanding achievement of its kind some twenty-seven years ago. In fact, the equipment is still producing today at top efficiency.

As builders, we had made an efficiency guarantee which, in the light of present-day knowledge, I must confess was based more upon faith and hope than actual knowledge as to what might be expected. Then came the time to run the efficiency test and determine whether the units had met contract conditions. I think that the purchaser's engineering representatives, as well as those of the manufacturer, felt a distinct delicacy about admitting to one another the limited extent of their knowledge of testing. At any rate, by common consent, each of the parties to the contract took its own readings and made its own calculations in rooms widely separated, although to their credit be it said they were in the same building.

There ensued many hours of silence in

(Continued on page 396)

COMPRESSOR DATA

Theoretical Horsepower Required to Compress 1,000 c.f.m. of Air at 14.7 Lb. Suction Pressure

Final Pressure	Comp. Ratio	n = 1.4			n = 1.3			n = 1.2			n = 1.0
lb.abs		Single Stage	Two Stage	Three Stage	Single Stage	Two Stage	Three Stage	Single Stage	Two Stage	Three Stage	Single Stage
30	2.04	51	48	47	50	47	47	48	46	46	45
35	2.38	63	58	57	62	57	56	59	56	55	55
40	2.72	73	67	66	71	66	65	69	65	64	64
45	3.06	83	76	74	81	75	73	78	74	72	71
50	3.40	91	85	82	89	83	81	85	82	80	78
55	3.74	100	93	89	98	90	88	93	89	86	84
60	4.07	110	98	95	106	97	94	100	95	92	89
65	4.42	118	105	102	112	103	100	107	101	98	95
70	4.76	125	111	108	119	109	105	113	106	103	99
75	5.10	133	116	114	125	115	110	119	111	109	104
80	5.45	140	121	119	131	120	115	124	116	114	108
85	5.78	146	126	122	137	124	120	129	120	118	112
90	6.12	151	131	126	142	128	124	134	124	121	116
95	6.45	156	135	130	147	132	128	139	128	125	119
100	6.80	162	140	134	153	136	131	143	131	129	121
105	7.14	167	144	138	158	140	135	147	135	133	124
110	7.48	171	147	141	163	143	139	150	139	136	127
115	7.82	176	151	145	167	147	142	154	142	139	130
120	8.16	181	155	148	172	151	145	158	145	142	133
125	8.50	186	158	152	176	154	147	162	148	145	136
130	8.85	190	162	155	180	158	150	166	152	148	139
135	9.18	194	165	158	184	161	152	170	155	151	141
140	9.52	199	169	160	188	164	155	173	157	153	143
145	9.85	203	172	162	191	166	158	176	159	155	145
150	10.20	207	174	165	195	169	162	179	162	158	148
160	10.88	215	180	171	202	174	167	185	168	163	152
170	11.56	224	185	175	209	179	172	190	173	168	156
180	12.25	232	190	179	215	184	176	196	177	172	159
190	12.91	240	195	183	221	189	180	201	181	176	162
200	13.60	248	200	187	228	193	183	207	185	179	166
210	14.30	256	205	192	234	197	187	211	188	181	169
220	14.95	264	209	196	239	201	191	216	192	184	171

Two- and three-stage compressors based on best receiver pressure and perfect intercooling.

Compressor Efficiency

Compression Ratio	2	3	4	5	6	7	8	9	10
Efficiency* single cylinder—percent	68	69	67	64	61	60	59	58	57
Efficiency* two-stage—percent	..	..	67	68	69	70	69	68	68

*Efficiency based on isothermal compression and includes mechanical losses.

© POWER

CYLINDER LUBRICATION IMPROVED ON Large Gas Compressors

By EZRA K. NICHOLSON
Cleveland, Ohio

AT THE du Pont Co.'s Belle Works several large high-pressure gas compressors gave trouble because of improper lubrication. In the February and April numbers of *Power* I told how these troubles were corrected in the crankshaft, crankpin and crosshead-pin bearings. This article describes changes made in the cylinder and piston-rod packing lubrication systems.

Originally there were two points of oil feed to each cylinder, approximately one-third the cylinder length from the ends of the cylinder and on opposite sides of the vertical centerline. Lubricant was introduced into the metallic rod packings at one point, between the first and second rings from the high-pressure end. Piston rings and packing rings had square edges. Due largely to the high pressures in these compressors, excessive wear of piston rings, cylinder walls, piston rods, and rod packings was soon evident.

We thought that maintenance cost on these items could be reduced by applying the principles that had reduced bearing maintenance on these compressors. This necessitated relocating the oil holes to introduce lubricant at points of lower pressure, and chamfering the edges of the piston rings and packing rings so that oil films could be formed and maintained between the piston rings and cylinder walls, and between packing rings and piston rods.

Points covered by the piston ring most remote from the piston's high-pressure face, when at the end of its discharge stroke, were found to be the correct place to supply lubricant to the high-pressure single-acting cylinders. It was also found that on these sizes of cylinder, from 8 to 18 in. diameter, effective lubrication could be had by supplying the oil at two points, one on either side of the vertical centerline, and equally distant from the cylinder head, as in Fig. 1.

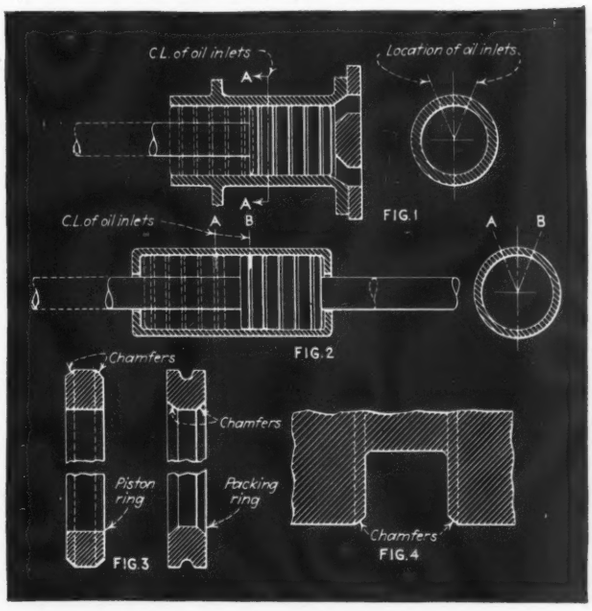
Points at which lubricant was supplied to the low-pressure, double-acting cylinders were located longitudinally so that the piston ring farthest from the pressure face of the piston covered the hole when the piston was at the end of the stroke. This required two different longitudinal locations. For the 18-in. cylinder it was found desirable to locate one hole on one side of the vertical centerline and the other hole on the opposite side, as in Fig. 2.

It is common practice, when lubricating metallic packings on piston rods, to introduce the lubricant directly on top of the rod and between the two packing rings nearest the pressure. This method is satisfactory for relatively small diameter rods and for pressures normally encountered. Although in this case the ring nearest the pressure causes the greatest pressure reduction, making the pressure at this point very nearly the minimum, it was found that, due to the large number of rings in these packings and the rather large diameter piston rods, extra points for supplying lubricant to these packings were necessary, at points farther removed from the pressure, in order to obtain effective lubrication. The radial locations of the points of lubrication introduction were not of importance because the space between the two packing rings where the lubricant was introduced acts as a reservoir.

Naturally, there are no distributing grooves in the surfaces of cylinders and piston rods. However, the spaces between adjacent piston or packing rings act similarly to the distributing grooves in bearings. With this conception in mind, the corners of piston rings and packing rings were chamfered as in Fig. 3. While square corners acted as excellent scrapers, allowing little lubricant to get between the rubbing surfaces, the chamfered corners permitted the forming of a continuous film of lubricant and materially decreased wearing of cylinder walls, piston rings, piston rods and packing rings. This continuous film of lubricant provided an excellent pressure seal which reduced gas leakage past the piston rings and rod-packing rings. The corners of the piston-ring grooves were also chamfered, as in Fig. 4, similarly to the corners of the piston rings, to assist in forming the oil film.

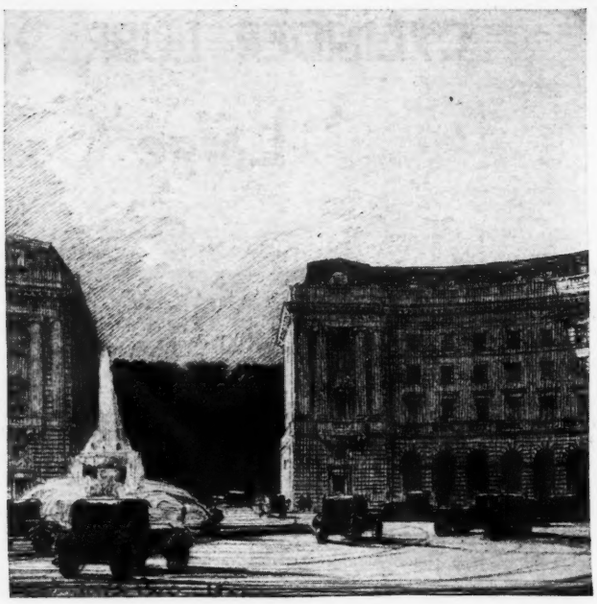
Making these changes in the cylinder lubrication systems reduced piston-rod packing and piston ring placements about half and increased reliability.

Fig. 1—Location of oil holes in single-acting cylinders. Fig. 2—Location of oil holes in double-acting cylinders. Fig. 3—Chamfering of piston and metallic packing rings. Fig. 4—Chamfering on edges of piston-ring grooves



By R. N. WARD
Mech. Engr., Syska & Hennessy

Three compressors, totaling 1,500 tons capacity, cool Washington's new Post Office Dept. Building. Liquid refrigerant is sprayed into water coolers by liquid pumps



LARGEST FREON REFRIGERATING PLANT

AIR-CONDITIONS NEW POST OFFICE

UNDOUBTEDLY the most outstanding mechanical features of the new Post Office Department Office Building, recently completed in Washington, D. C., are the air-conditioning and refrigerating plants. This new structure, air-conditioned throughout, has an exterior finish of granite and limestone and occupies a ground area of 261,000 sq.ft. It is eight stories high and has a total volume of fourteen million cubic feet.

Steam for heating is furnished from the government's new central heating plant, described on page 373. For summer cooling, a 1,500-ton Freon refrigeration plant has been installed within the building to furnish chilled water for six spray-type dehumidifiers. Condensing cooling water is supplied from the tidal basin of the Potomac River or from either of four indoor cooling towers. All electric power is purchased from the Potomac Electric Power Company.

It will be observed from Fig. 1 that the exterior walls of the building are for the most part curved. This architectural feature, together with several interior open courts, presents a building plan of unusual shape.

This structural complexity has resulted in three separate systems of distribution for conditioned air and four distinct methods of heating.

With the exception of certain spaces in the attic and basement, the building is completely air-conditioned. Conditioned spaces include all general office and file space of the Post Office Department, the office of the Postmaster General, a model post office on the first floor and a cafeteria in the basement.

Certain parts of the air-conditioning system; namely, the compressors, water coolers, condensers and circulating pumps, together with one dehumidifier, are centrally located in the basement. Four condensing water cooling units, referred to as cooling towers, as well as five dehumidifiers, are on the eighth floor. The latter are positioned to serve five different zones or sections of the building. This arrangement of equipment permits flexible operation and simplified installation of the air-distributing duct system.

The general arrangement of the refrigerating plant and inter-connecting piping is shown in Fig. 2. The plant is divided into three separate units, two of 600-ton capacity, and a third unit of 300 tons. This division of the refrigerating capacity gives considerable flexibility and permits economical operation of the plant.

The two larger compressors are of the duplex type, each consisting of two 15x11¾-in. reciprocating compressors direct-connected to a single 700-hp., 2,300-volt synchronous motor to operate at a speed of 257 r.p.m. The third unit is a single 15x11¾-in. compressor direct-connected to a 550-hp., 2,300-volt synchronous motor to operate at the same speed. Each compressor motor has its own motor-generator set for excitation.

All compressors are of the vertical, 4-cyl., single-acting type, designed and built expressly to use Freon. These compressors follow closely the design used in ammonia practice except that the shaft seal and stuffing box are somewhat longer than would be used for ammonia work. By-pass valves are provided on all com-

Fig. 1—Air conditioning the new Post Office Building, here seen from the Great Circle, requires 1,500 tons of refrigeration

pressor cylinders to permit operation at partial loads at most economical horsepower consumption.

During normal operation it is the intent to operate any one of the three compressor units with its respective condenser and water cooler. However, cross piping connections have been provided to permit various operating combinations of compressors, coolers and condensers in cases of emergency.

The Freon condensers are of the multi-pass shell-and-tube design of welded construction throughout. Two of the condensers are 55 in. dia. and 20 ft. long, each containing 1,528 $\frac{3}{4}$-in. tubes, totaling 6,000 sq.ft. The third condenser is 10 ft. long and has 1,528 $\frac{3}{4}$-in. tubes with 3,000 sq.ft. of surface. All condenser shells are of $\frac{7}{16}$-in. steel boiler plate and have cast-iron heads. The tube sheets are 2-in. thick steel and are substantially braced by tie rods.

The shell-and-tube water coolers are of the same general design and construction as the condensers, but in addition are provided with a header and series of nozzles in the upper portion of the shell for spraying the liquid refrigerant. All coolers are designed to cool the chilled water from 48 to 41 deg. when operating the compressors at a suction temperature of 30 deg., corresponding to a gage pressure of 28 lb. per sq.in.

A vertical liquid refrigerant pump, delivering several times the amount of liquid evaporated, supplies the liquid refrigerant to each water cooler. This method of feeding liquid refrigerant permits the entire evaporator surface to be wetted under all load conditions, and at the same time permits a small charge of refrigerant to be carried in the system. While this method of feeding and circulating a liquid refrigerant is not new, its application to water-cooling installations for air conditioning is of comparatively recent practice with this

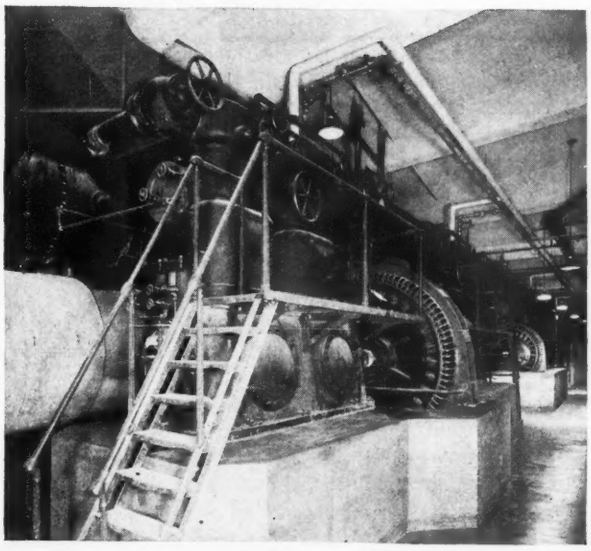
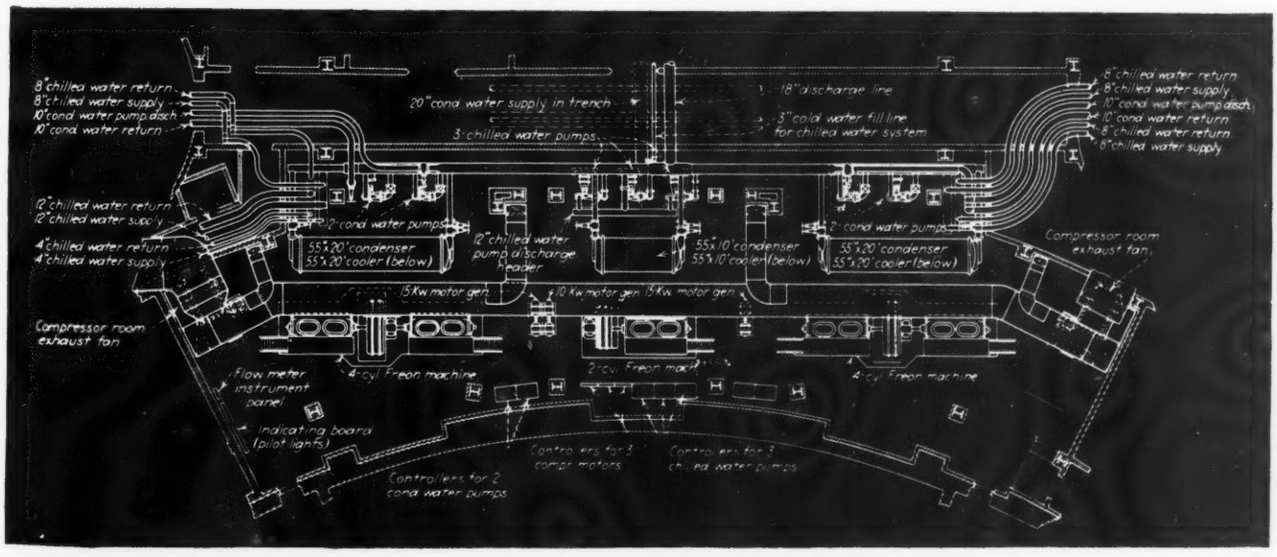


Fig. 2 — Three York compressors supply refrigeration for air conditioning

Fig. 3—General arrangement of refrigerating equipment



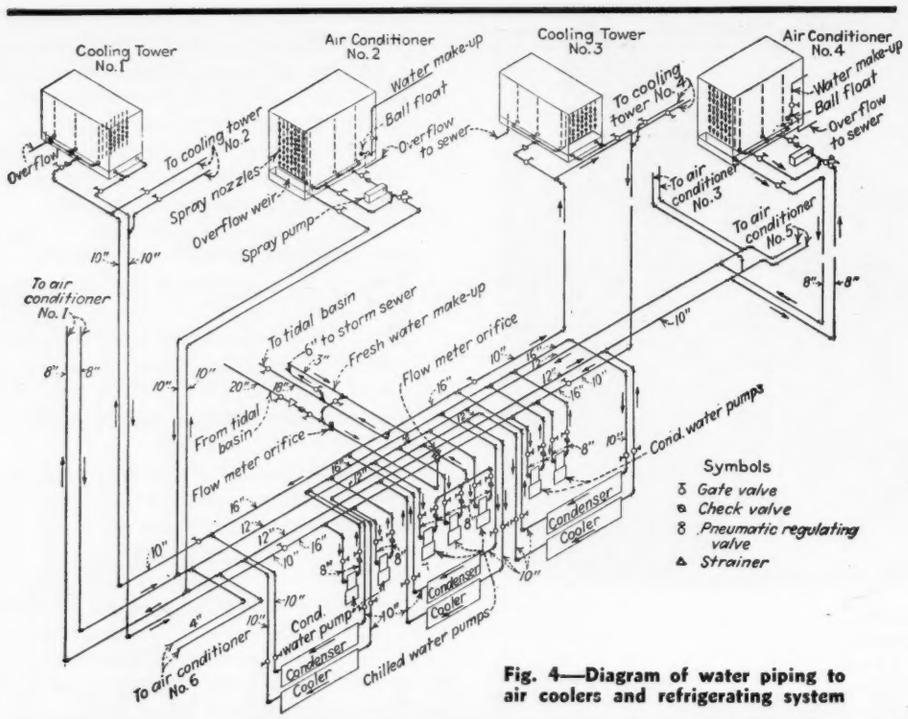


Fig. 4—Diagram of water piping to air coolers and refrigerating system

particular type of building refrigerating equipment.

Water from the tidal basin will be used for condensing purposes during normal operation. This water, at the rate of 5,800 g.p.m., will be delivered to the compressor room through a 20-in. main, as indicated in Fig. 3. This main connects with a new underground water distributing system recently installed to furnish condensing water to a number of air-conditioned Federal buildings. After passing through the condensers, the cooling water is returned to the tidal basin, discharging at a remote point.

At certain times of the year, or in cases of emergency it may not be possible to use tidal basin water for the condensers. During such periods the cooling towers are to be operated. The four towers have a combined capacity to cool 5,800 g.p.m. to 82 deg. when circulating 480,000 cu.ft. of air per minute at a wet-bulb temperature of 75 deg.

Each cooling tower consists of a spray-tube air washer connected to a squirrel-cage type fan, driven by a 40-hp. constant-speed motor. Air washers were selected for cooling the condensing water for two reasons: first, because of space limitations, and second, to keep all apparatus within the building to preserve architectural treatment.

The air washers are of the conventional design, provided with three banks of spray nozzles, an overflow weir, water eliminators and an automatic ball float for maintaining constant water level in the sump tank.

Outside air is drawn into each air washer through its respective air intake on the court side of the building, and is discharged vertically through an opening in the roof at a velocity of 2,800 ft. per min. Discharging the air at this high velocity will reduce recirculating humid air.

All dehumidifiers, like the cooling towers, are conventional 3-bank spray type. The largest dehumidifier will cool 45,000 c.f.m. of air to 50 deg., while the total capacity of all dehumidifiers is 205,000 c.f.m.

Cooling tower and chilled water are distributed through an extensive system of piping. Fig. 4 is a composite flow diagram. Four centrifugal pumps in the compressor room circulate cooling tower water. Each pump delivers 1,275 g.p.m. against 100-ft. head and is driven by a 40-hp. direct-connected squirrel-cage motor.

Three main circulating pumps distribute chilled water to the various dehumidifier spray pumps. Each pump has a capacity of 1,700 g.p.m. against a 90-ft. head and is driven by its respective 60-hp. direct-connected squirrel-cage motor.

The quantity of chilled water admitted to the spray-pump inlet is governed by the pneumatically operated diaphragm valve indicated in Fig. 3. During winter operation when chilled water is not required, the main circulating pumps are removed from service, and the spray pumps only are operated. The spray pumps are rated at 1,000 g.p.m. at 70-ft. head and are driven by 25-hp. direct-connected squirrel-cage motors.

In designing the system considerable thought was given and equipment provided for reducing corrosion. A dry chemical feeder is installed at each dehumidifier for introducing a water-treatment compound for maintaining a constant pH condition. This compound is a standard commercial material and is fed into the system at varying intervals by manual operation of the feed and mixing valves. The pH of the water is determined by noting the color change of a test sample of chilled water when compared with a conventional block comparator. Acidity of the condensing cooling water is not controlled, as this will for the greater part of the time be non-recirculated when using tidal basin water.

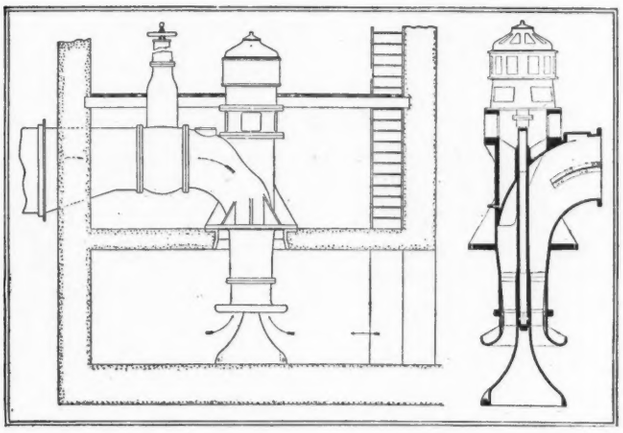
In addition to treating the chilled circulating water rubber gaskets are inserted in the joints between two dissimilar materials to prevent corrosion due to electrolytic action.

The air distribution and heating systems of this new building will be described in the August number.

PROPELLER-TYPE CIRCULATING PUMPS Applied To SURFACE CONDENSERS

By C. B. TULEY

Steam-Condenser Engineer,
Westinghouse Electric & Manufacturing Co.



Left—Typical propeller pump installation on a steam condenser. Right—Section through 48-in. propeller pump for condenser.

PROPELLER pumps are being increasingly used as circulating pumps for surface condensers. They are particularly well-suited for single-pass condensers, where total pumping head is usually low and required capacity is relatively great.

For a given head, capacity and efficiency, designed speed of propeller pumps is higher than that of other types. Pump and motor are, therefore, smaller and the motor cheaper. For example, for 40,000 g.p.m. and 18 ft. total head, a propeller pump would operate at 575 r.p.m., whereas a centrifugal pump would operate at 245 r.p.m. and an axial-flow pump at 345 r.p.m. For any of these pumps a 350- or 300-hp. motor would be used. In an installation involving two pumps the saving in motor cost due to the higher speed exceeds the cost of piping, valves, or controls used for starting the second pump.

Another feature of the vertical propeller pump is the small floor space occupied in comparison to either a vertical or horizontal centrifugal pump. A propeller pump inherently lends itself to location in the circulating-water intake tunnel. There are cases where extreme low-water level will be 20 ft. or more below the condenser basement floor. If a horizontal centrifugal pump is located on the basement floor, a high suction lift will be encountered, with resultant loss in efficiency. If a vertical centrifugal pump is used, the high suction lift will prevail if the pump is set on the basement floor. When it is located in the intake tunnel, the pump will probably be inaccessible for repairs during periods of high or mean water levels. The propeller pump can be made with extended body and shaft, so that the discharge part of its body and the motor will be above the basement floor, while the propeller is located below extreme low water and is always submerged (see Figs. 1 and 2).

The pump is always accessible for repairs or inspection, regardless of water level. Its upper flange can be set above high-water level; by removing the bolts in this flange, the rotating element and guide vanes can be lifted out. This is of special value where high water level is above the condenser basement floor. The motor can be mounted either on top of the pump or on a floor above with an extension shaft.

With the propeller below extreme low water there is no chance for air infiltration through the glands as in the case of the centrifugal pump operating against a high suction lift. Possibility of trouble with tube-end erosion due to air in the circulating water is thus avoided. There is also no danger of the pump losing its prime due to breaking of the suction vacuum.

The propeller-pump's high shut-off-head characteristic is an advantage. In practically any installation the levels are such that should the auxiliary power be lost temporarily, the pumps will immediately start circulation without previous priming of the circulating system, without overloading the motor excessively. Head required to raise water to the top of the circulating system and thus establish the syphon is less than shut-off head of the pumps. The normal characteristic of a centrifugal pump is rather flat, the shut-off head usually being only slightly greater than that at normal operating conditions. Therefore, when the syphon is broken for any reason, the circulating system must be primed before circulation can be resumed.

The propeller pump is inherently a low-head type. At the point of best efficiency the designed total head should nominally not exceed about 30 ft. Propeller pumps, therefore, are rarely applicable to multiple-pass condensers, but are ideal for single-pass designs.

The head-capacity characteristic curve of a propeller pump is steeper than that of a centrifugal pump. Head drops more rapidly with increase in capacity than does that of the centrifugal pump. Therefore, for application of two circulating pumps to a condenser it will usually be found that, with one pump operating alone, a smaller capacity can be obtained with the propeller pump than with a centrifugal pump, when both are designed for the same head and capacity with both pumps operating.

FIFTY YEARS

(Continued from page 389)

each of the rooms from early evening until far beyond the midnight hour. The calculations of each group had long been completed but reluctance prevented the rival camps from making the first overtures to the conference which had to follow. In due time, this being overcome by dint of much diplomatic maneuvering, official representatives of the parties at interest, both said, as if by one breath, "Well, what efficiency have you?" Again, as by common consent, silence fell. Gradually and amid many hesitations, of course, both groups admitted efficiencies which, to this day, I may say have never been reached, far less exceeded. Subsequently, both groups agreed that in all probability their calculations were incorrect and that by the same token there was little likelihood that any proof could be presented that the efficiency guarantees which had been made by the manufacturer were not met.

Having thus arrived at this happy meeting of minds, the jubilation continued in righteous celebration of the event until long after dawn. Every one was happy, and the manufacturer of the hydro-power machinery had acquired a justly earned reputation for high-grade engineering. At any rate, if there was a lack of strictly scientific procedure in the matter of testing for efficiency, it was, in those days, more than over-balanced by a quality of workmanship, material and mechanical design which bespoke a rugged honesty of purpose, of which we have not too much in our businesses even to this day.

ELY C. HUTCHINSON,
President,
Edge Moor Iron Company.

The Power Job Today

• MY MIND travels back over my twenty-odd years as a participant in the "power game," if I may call it such. In trying to get a start I was convinced I needed friends and in my search I was introduced to none other than that genial entertainer of by-gone days, Jack Armour. Needless to say, the engineers I met through Jack have proved life-long friends to whom I owe in a large measure whatever success I have attained in the operating field.

As I look back over the changes and improvements which have taken place, especially in the refinements of machines and equipment now at the disposal of the operating engineer, I am inclined to marvel—and why not. I have only to think of my own "hotel job" with a boiler plant using powdered coal, steam driven-electric generating equipment using less than 30 lb. of steam per kw.-hr., refrigeration not alone to make ice and chill refrigerators but to keep the dining rooms and ball rooms cool and air-conditioned no matter how hot the summer day may be. The power-plant auxiliaries are all motor-driven, modern push-button automatic elevators are used, every guest room has a radio, while a public address system in the ball rooms and dining rooms is an absolute necessity. Circulating ice water in all parts of the building is quite commonplace; even the kitchen and bake shop cook and bake with electricity—and it is all taken as a matter of course.

Of all these improvements, possibly the one most destined to change our mode of living is air-conditioning, a few years ago an engineer's dream, today a dominating feature in modern building design. But even now this modern necessity is in its infancy and the present methods of achieving its results will soon seem crude and expensive. When "cooling" can be circulated in our buildings as easily as "heating," I believe we will be approaching the perfection in this service which we are all looking forward to.

And what an improvement for the "Chief's job." He can't use shovels because they are "out of date." Engines are self-lubricated, so his oil can is left on the shelf. Motor-driven machines have relegated the old packing jobs to the realms of memory, while modern boiler water treatment has spoiled the turbining of boiler tubes, and so on through the plant. Which all means that in spite of the depression, the New Deal, and what not, the old world is a pretty good place to live in, and maybe an operating engineer does not have the worst job in the world after all.

W. D. LEWIS,
Chief Engineer,
Hotel New Yorker.

A Line from "Breck"

• I HAVE, on two occasions, visited the Grand Canyon. The first time I stayed three days, the next time ten. I have never been able, and I believe it would be impossible, to describe the Grand Canyon or say much of anything about it that would convey to another person the impressions I received while there.

I feel the same way about my fifty years association and observation in connection with the problems of power. There have been so many experiences, some very small, some very large, that I should despair in concentrating in twenty pages the things I have enjoyed and felt about the problems of power that have come to my notice.

Just now I am getting settled in Vermont after my winter in Italy and in spite of the feelings within me, and my desire to say a few words about your splendid Fiftieth Anniversary Number, I think it will be wise to be content and just congratualte you on what you have done to set forth the wonders of power during fifty years of its existence.

L. P. BRECKENRIDGE,
Professor Emeritus,
Yale University.

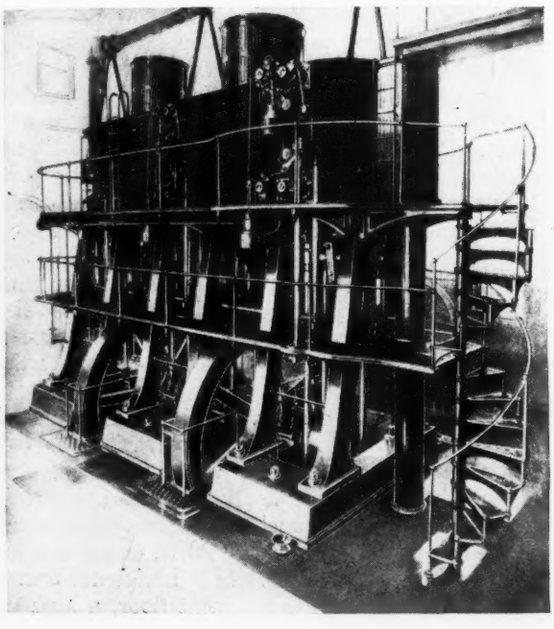
Over the Horizon

• AS LATE as 1920 the A.S.M.E. standardization of flanges extended to a maximum of only 250 lb. per sq.in. and the Prime Movers Committee of the N.E.L.A. in its report of the same year (1920) stated that, "At the present time 300 lb. with a total temperature of from 650 to 700 deg. F. may probably be taken as a conservative limit, and even under such conditions a high degree of operating skill is required even when the best obtainable apparatus is installed." Compare this statement in light of the developments in power plant practice during the past decade and particularly from 1924 to 1929, when great strides were made not only in the amount of power consumed but also in the economy of power production.

What of the future of the power industry? Fifty years ago, when the magazine *Power* appeared on the horizon, the power industry was only about two years old. From a very small beginning in 1882 the power industry has reached a magnitude which is represented by an investment of more than two billion dollars in equipment. The normal growth of any industry requires a constant and rapid replacement of

At left, Barr pumping engine built for the Washington, D. C., water works, 1904. At right, Knowles pumping engine at Clear Stream Station, Brooklyn, N. Y., 1905

•



equipment in order to keep its product up to date. Much present power-generating equipment is obsolete and, accordingly, there is a potential market of millions of dollars annually to cover replacements of and repairs to power plant equipment. It should also be realized that any appreciable improvement in business will quickly absorb such excess capacity as our power plants now have and there will be a demand for new equipment. Furthermore, it is reasonable to suppose that new industries will be developed in the future as was the case in the past, and that a very marked increase in the demand for power equipment may be expected, *if the power industry does not neglect research which is "the door of tomorrow."*

The power industry must make use of new science to meet the changing conditions and to insure future programs with a degree of certainty. The most successful manufacturing industries of this country, which have best weathered the depression, have been spending from one to four per cent of their income, even during the difficult period of 1930 to 1933, in order to keep ahead of practical applications. It is difficult to estimate the research expenditures of the power industry during the past four years, but my message to the power industry is "take stock of your research activities which represent the insurance you must be willing to pay for in order that your products may show constant improvement and so that your services may be adaptable to the changing needs of the times. Research is the fountain of youth which, if neglected by any industry, results in stagnation and defeat."

My best wishes for the success of *Power* during 1934 to 1984.

A. A. POTTER,
Dean of Engineering,
Purdue University.

"Prometheus Bound"

• I RECALL visiting Fred Low at his summer home in New Hempshire and hearing him tell how the power line penetrated the valley in which his place is located. A former neighbor "went along" with the rest so as to get the power line in to the valley. A light in the barn would be useful and less dangerous than a lantern. One light—that's all he would use. But the house was wired as well as the barn, and motors were bought for dairy and woodshed, electrical milking machines followed, and irons, washing machines, vacuum cleaners, radio, and many other contraptions in house and buildings. With each a certain amount of hard work disappeared, and conveniences that made life pleasanter to live appeared. The outside world crept up the valley with the power line, brought by the radio, and another leap was placed between man's existence and possessions and the encroaching environment of a stern New Hampshire countryside that threatens always to overtake the weak and the indolent.

In city, town, and rural countryside throughout our nation this same transformation has been taking place. The men who have brought it about have not been the dwellers in flats or the toilers on farms, but the engineers and utility operators who have run the wires down the street and over the hills and said, "Here it is, use it and the more you use of it the cheaper it will be for all of us." As a result, what was an undreamed-of luxury has become a commonplace of home and shop.

With the passing of the first wonder of putting hand to switch and seeing light burst forth, or water gush from the pump, the greedy Caliban thinks, "This is no miracle, but a devilish plot to take my money by making a monopoly of a life-sustaining necessity. Out upon these predatory wretches who filch my pennies for what my government would give me for a song. Tax them, jail them; confiscate their property and let us take it for ourselves. What right have they to withhold the God-given blessing of electricity?"

The cycle is complete. Once more Prometheus is bound and vulture-tortured for having taken what lesser mortals feared and were too blind to touch. Nevertheless, the whole category of petty crimes and selfish lapses that whining critics recite against the electrical industry can never cast more than a pale shadow across its astounding accomplishments—accomplishments that would never have been completed so rapidly or extended so broadly had they not been the work of individuals seeking personal profit and satisfaction, rather than bureaus standing in their own light and in the light of others, diligent to repress and punish, and lacking the desire and the ability to progress.

Perhaps the enunciation of this old-fashioned doctrine will justify your classing me with those old enough to have "recollections."

Good luck to your issue. I wish I had the kind of "recollections" you asked for. As for this outburst, it has been good to get it off my chest, so I'll send it along anyway as an acknowledgment of your letter.

GEORGE A. STETSON.
Editor, "Mechanical Engineering."

The "Good Old Days"

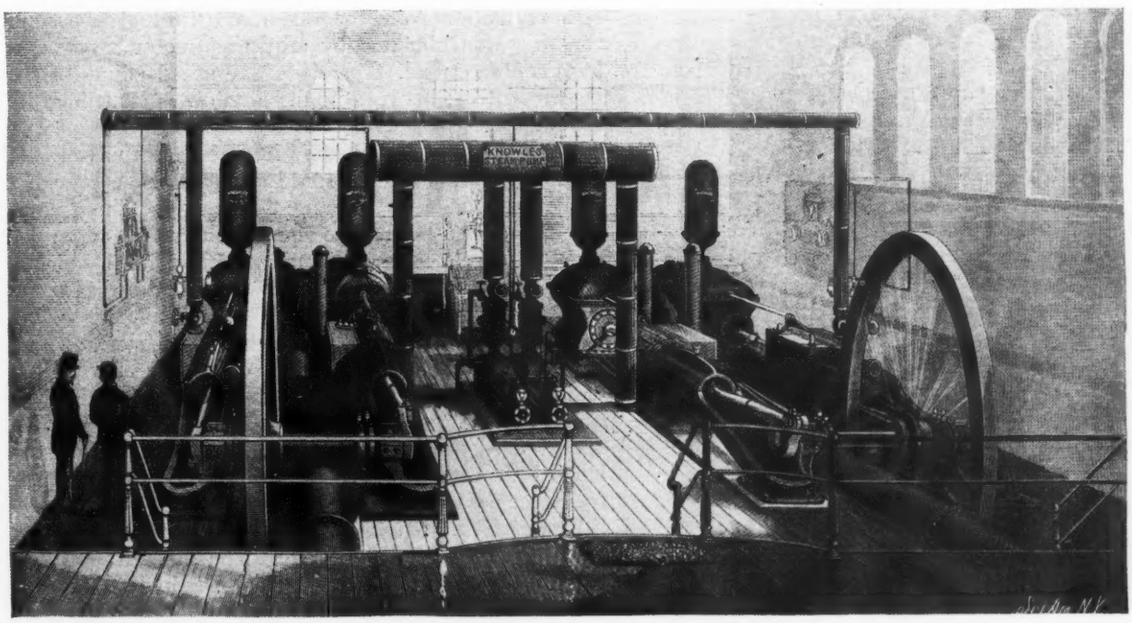
○ AS A subscriber to *Power* for nearly fifty years, I have seen the old paper keep abreast of the times. First the throttling slide-valve engines, then automatic drop cutoffs, shaft-governing engines belted to counter-shafts, and high-speed direct-belted, direct-connected units; finally the modern turbine.

I sometimes wonder what present-day operators would think of the old generators in which the brushes had to be rocked ahead or back to avoid a stream of fire around the commutator when the load changed a little. Also the old engines which would give you a 10 per cent or more variation in speed with no effort at all.

These were the days when the operator had no more use for a chair than a marathon runner. Surely these were "the good old days."

E. W. FURBUSH.
Greenfield, Mass

These "reminiscences" will be continued in August—Editor.



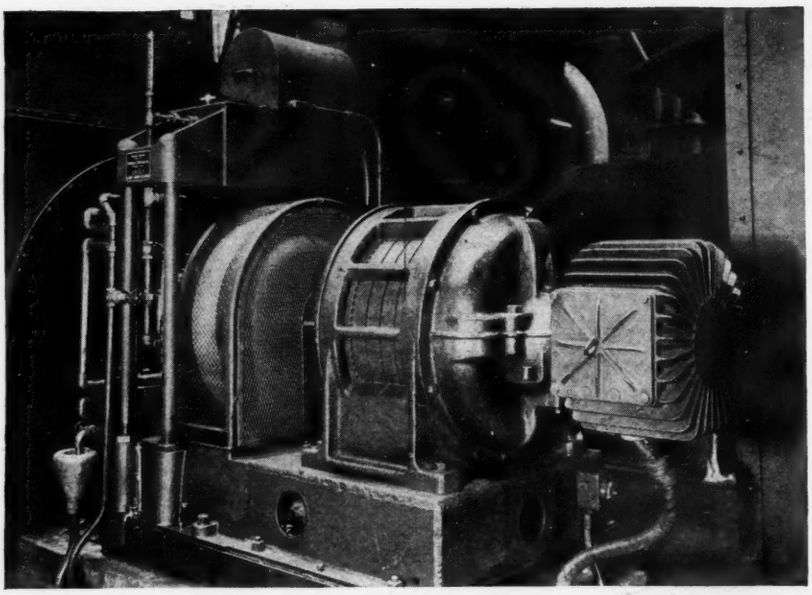


Fig. 1—Hydraulic coupling installed on 125-hp. motor driving forced-draft fan

Power savings on a forced-draft fan drive reached 27 per cent when constant-speed motor and hydraulic coupling were used instead of a variable-speed motor and solid coupling

HYDRAULIC COUPLING

SAVES 27% ON FORCED-DRAFT FAN POWER

WHEN Philadelphia Electric Company engineers were considering the 165,000-kw. extension to Richmond Station, now being built, it was decided that possibly a constant-speed motor with a hydraulic variable-speed coupling might better meet the requirements, where speed adjustment is required, than would variable-speed motors. With this object in mind a hydraulic coupling was installed on one of the forced-draft fans in that plant and an extensive series of tests conducted on it and on another fan in the same service, but driven by a wound-rotor variable-speed motor.

This coupling, which is based on the original design of Prof. Fottinger in Europe, is built in this country by the Hydraulic Coupling Corp. Fig. 1 shows the coupling installed. There is no mechanical connection between the driving and the driven parts of the coupling. The driving part is keyed to the motor shaft and acts as the impeller of a pump to deliver fluid to the driven part, which may be considered a water wheel.

Oil is the driving fluid and is continuously circulated through the coupling. The difference in speed between the input and output parts of the coupling depends upon the amount of oil in the coupling. With the coupling full, slip is less than three per cent, and when the coupling is empty its output half rotates at about 20 per cent motor speed on fan service.

To make the tests, a hydraulic coupling was installed on a forced-draft fan, normally driven by a 125-hp. wound-rotor motor with five points of speed control. No changes were made in the equipment other than to replace the solid coupling by a hydraulic type. As shown in Fig. 1 the coupling base was extended by a welded-plate construction to support the motor, which, since installing the coupling operates at constant speed.

Indicating meters were installed to measure the input to the motor driving through the hydraulic coupling and to a motor driving an identical fan on an adjacent boiler, connected by a solid coupling. Test runs were made, during which each motor's input, quantity of air (as computed from the boiler output), differential pressure across the fan, and the wind-box pressure, were measured. The motor driving through the hydraulic coupling was run at constant full speed, and all regulation was obtained through the coupling. The damper in the fan discharge was maintained in wide-open position. Air-flow regulation from the fan driven through the solid coupling was obtained by adjusting motor speed and by damper control. There are five speed points in the motor control; between points air flow is controlled by the damper.

With the indicating meters in place, tests were made to determine the rate of speed-change response. These tests were made by varying the speed of the fan in increments and noting the changes in fan speed, wind-box pressure and motor input. When these various quantities had become stable, it was considered that the change was complete.

Integrating watt-hour meters were then substituted for the indicating meters, and daily readings of the motor input and of the quantity of coal burned in each of the two boilers under test was made. The cumulative energy used was then compared to the cumulative coal burned to establish a comparison of operating performance between the two units.

The curves, Fig. 2, show the relation between fan speed and wind-box pressure. The smooth dot-dash curve is for the fan driven through the hydraulic coupling and the stepped curve is for the fan, the speed of

which was controlled by regulating the motor's speed. The dotted curves show windbox pressure, on each point of speed control, that may be had with damper adjustment.

In Fig. 3, motor power input is plotted against windbox pressure. The fan driven through the hydraulic coupling, in general, requires less motor input for the same output than the fan driven through the solid coupling. When the damper is open, input is practically the same for both drives. This occurs only at five points and indicates that the inherent losses in both types of speed control are practically the same

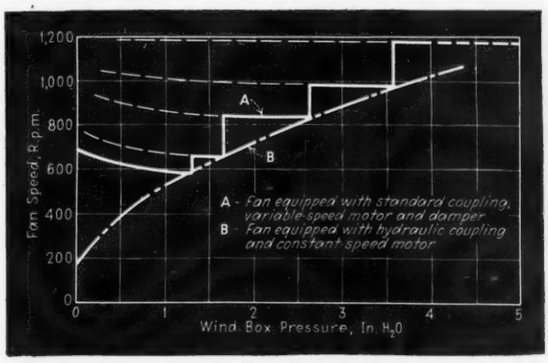


Fig. 2—Relation between fan speed and wind-box pressure

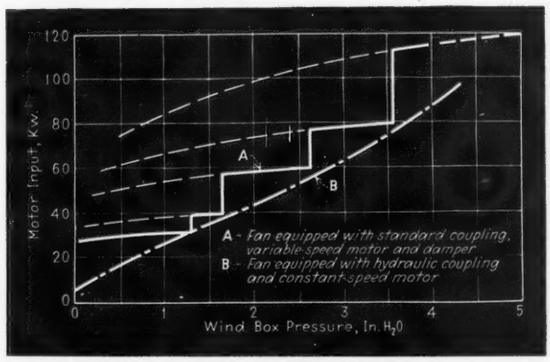


Fig. 3—Relation between motor power input and wind-box pressure

and that the saving in power from use of the hydraulic coupling results because the damper is always in the open position. In other words, the hydraulic coupling makes possible an infinite number of speed control points, where with the electric control, in this case, the speed points are limited to five.

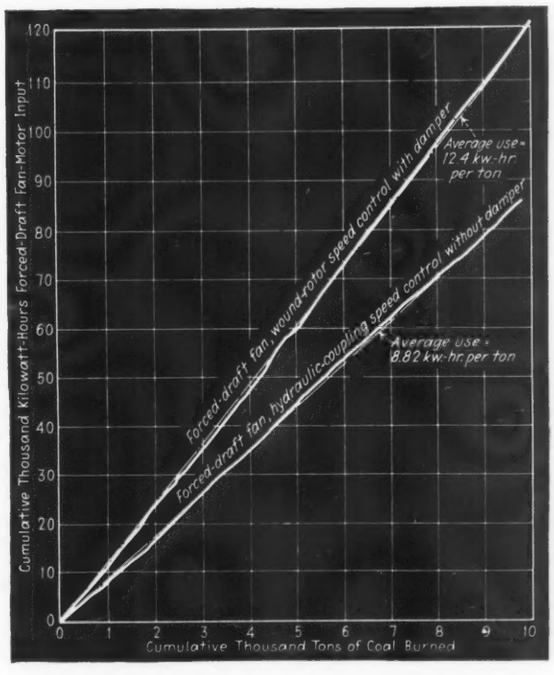
On Fig. 4 are plotted the results of a long series of tests during which nearly 10,000 tons of coal was burned under each of the two boilers equipped with the test fans. From these curves the cumulative power input to the fan motors was plotted against the cumulative tons of coal burned. The fan driven by a solid coupling required 12.14 kw.-hr. per ton of coal burned, the one driven by the hydraulic coupling took only 8.82 kw.-hr. per ton, a saving of 27 per cent. This checked satisfactorily with the curves of Fig. 3, since the normal wind-box pressure is about 2 in. of water. At that pressure the input to the electrically controlled fan is 58 kw. and to the other 43 kw., a reduction of 26 per cent.

In the tests on the rapidity by which changes in fan speed could be made it was found that an increase from 150 to 410 per cent of boiler rating could be accomplished in about one minute. On a reduction in load the response was somewhat slower. For example, while reducing the load from 410 to 150 per cent rating, only about 75 per cent of the reduction was accomplished in one minute. Then it required about two minutes more to reach the 150 per cent rating. From this it is seen that the response to load change is more rapid on load increases than on reductions. In either case the response is slower than with a damper, which is almost instantaneous. There does not seem to be any reason in this case, however, for requiring such rapid control of air flow. The coupling is now in regular operation and meeting all service requirements.

A modified design of the coupling can be used where a more rapid speed response is desired. In this type changes in speed are obtained by removing or delivering oil to the coupling by a rotary pump direct-connected to a small reversible electric motor. Direction of its rotation is controlled automatically or by a pistol-grip switch and the pump operates only when a speed change is desired.

Conclusions that may be drawn from these tests are that a saving of about 25 per cent may be made, compared to controlling the air flow by adjusting the motor's speed and damper position. The equipment has a sufficiently rapid speed-change response for most applications where speed control is required. A range of fan-speed control of from less than 20 to over 97 per cent of the prime mover speed can be obtained. After a period of operation covering about one year, during which about 15,000 tons of coal were burned, no serious operating troubles have been encountered. From the results of these tests it has been decided to install this type of coupling on the condensate-pump drives and probably on all forced- and induced-draft fans in the extension to Richmond Station mentioned in the first paragraph.

Fig. 4 — Cumulative coal burned compared to cumulative power input to forced-draft fan motor



RESOLUTIONS and CAMPAIGNS

CAN'T STOP SMOKE

By HOWARD W. EVANS
Smoke Abatement Engineer

THE City of Chicago last March completed the most comprehensive smoke investigation ever conducted in this country. It was carried on under direction of Frank A. Chambers, smoke inspector, was supervised by a board of six "engineers in charge," and 136 engineers constituted the field corps. CWA funds to the extent of about $65,000 were expended.

Many indisputable facts were determined, and they have enabled the engineers in charge to make definite recommendations to abate air pollution, one of the most perplexing problems confronting municipalities. For the first time, a definite plan has been outlined for abatement.

My intent here is to lay bare these facts and to arouse everyone from his lethargy to urge that political power be consolidated and actual steps taken by responsible city authorities to abate the smoke nuisance. We have been fed up with periodic promises. In spite of all efforts, the past 25 years included, very little has been accomplished. It is, therefore, time to tell the public truthfully why this is so.

The first thing to understand is the great difference between visible smoke and the nuisance due to the atmospheric discharge of the products of combustion; i.e., soot, fly-ash, cinders, dust and noxious gases. It is the combination of all these factors which constitutes the smoke nuisance. Smoke accounts for the color of stack discharge only; solids and gas for the greater destruction to health and property.

Property damage chargeable to smoke has been estimated at $2,500,000,000.00 per year for the entire country; at $15 to $20 per capita per year for all city dwellers. Soot and solid fall in Chicago is in excess of 600,000 tons per year; an average over 250 lb. per city block per day. This is typical of all large cities.

Each particle of soot and solid matter has a sulphurous content, and when moistened by air or water becomes sulphuric and readily adheres to anything. It destroys in ever-increasing quantities. The silicon particles wreck havoc with our respiratory organs, and increase morbidity and mortality in many diseases.

Many factors have prevented a solution of the problem ere this. It is no longer because of a lack of knowledge. Politics enters the picture at the outset. Authorities to date have shown no inclination to pass a proper ordinance. They also prevent the enforcement of the half-way measures now on the statute books, which however will not abate the nuisances even if enforced. Smoke inspectors are either afraid of their jobs, hesitate to ask for an ordinance which might abate the nuisance, lack knowledge of the subject or the "guts" to do anything about it.

The smoke nuisance has been a civic problem throughout the centuries and though it can be solved, citizens have not demanded that it be done. No city in the country now has an ordinance which, as at present written, will abate the smoke nuisance—that is, eliminate it! The fact is, all city ordinances in effect today actually permit smoke and it is time to tell the public all the facts. They should no longer be kidded by experts.

For the sake of legality in the gesture of enforcing existing ordinances, smoke is measured by density. The Ringleman Chart is recognized as a measuring standard which determines by color the degree of density. All existing ordinances permit smoke of the greatest density for a prescribed time allowance—a few restrict the occasions for such emission. Few prosecutions develop from infractions, however. No existing ordinance prohibits smoke of density less than No. 3 (60 per cent black) per se. Under these circumstances, how can the public expect abatement of the nuisance?

The Chicago investigation was carried on along the lines of previous investigations in other cities, notably Salt Lake City, St. Louis, Cleveland, and Pittsburgh —that is, by publicity to encourage citizens to become smoke-conscious; by observing and reporting violators of the existing city smoke ordinance; by actual instruction in smokeless firing methods; by consultation with owners as to the installation of modern stoking equipment. All these things have been done before and *never* need be done again. This campaign has proven the futility of such methods; human nature is not amenable to such idealistic procedures.

The erroneousness of this method of attack is indicated by a city smoke inspector who said, "The average plant operator is not amenable to persuasion, the great majority will not trouble themselves to abate smoke unless compelled to do so." In some cities campaigns to abate the smoke nuisance were burlesqued simply by trying to lessen the volume of dense smoke, that is, of No. 3 or heavier, with little or no attention paid to smoke of lighter density and no attention whatever to the abatement of the solid discharge nuisance which is worse than smoke. Such campaigns will continue to be failures. You cannot abate the nuisance simply by changing the color of the smoke.

The reason is the method of attack. Why won't men engaged in this civic activity realize and admit that the smoke nuisance will never be abated simply by reducing the volume of dense smoke? They should know by this time that smoke of any density, and especially the solid discharge, must be definitely stopped to get anywhere at all in this fight for a clean atmosphere.

All that city smoke inspectors have done to date is to reduce the total volume of dense smoke. The result has been simply a change in the color of smoke emission below the prohibited shade, but *the volume of lighter smoke, solids and gas discharged has been increased.* The net result, as far as abating the smoke nuisance is concerned, is below zero.

I have spoken only of smoke; unfortunately, that isn't the half of it. The good citizens who interest themselves in the civic problem of smoke abatement are usually in utter ignorance of the problem as a whole. They have reached this conclusion, "Oh, if my city would only stop the black smoke coming out of the stacks, how clean we would be." Piffle!

The extreme menace to health attributable to this scourge is from the *solids* and invisible gases emanating from the stacks and in a much lesser degree from smoke. It is easy to explain this. Except for ash-pit refuse, all products of combustion must be discharged through the stack in the shape of fly-ash, cinders, dust, gases, unburned carbon and tarry products. The entire mixture flies around like down and sticks to anything touched; erosion and corrosion at once begin their deadly effect throughout the area of dissemination.

Now better combustion may reduce the density of smoke, but fly-ash and cinders are thereby produced in *greater* quantity. Being more thoroughly burned they are lighter and easier to carry up the stack.

The menace to health and the destruction to property caused by this scourge is recognized by all authorities. Dr. Fred O. Tonney of the Chicago Health Department recorded in the American Journal of Public Health in April, 1933:

"Efforts to abate the smoke of ordinary fuels to a sufficient degree to save the ultra-violet light of sunshine have thus far proved inadequate. The results have been apparent in greater visibility, cleanliness and economy of fuel rather than in material saving of ultra-violet light.

"In Pittsburgh, an intensive 10-year program of smoke abatement by forced-draft combustion methods succeeded in reducing the visible smoke due to unburned tarry matter, but increased the total deposit of dust particles in the air about 40 per cent. Although the dust and ash particles, according to recent experiments, are somewhat less opaque to ultra-violet light than that of soot and tarry matter, they are, nevertheless, definitely opaque, and the greatly increased amount of ash and dust would seem to offset the advantage of complete combustion by forced-draft."

During the recent investigation a questionnaire was sent the leading health authorities throughout the country. One of the questions asked was: "Which do you consider the more harmful to health, inhalation of (a) Carbon (soot), or, (b) Fly-ash." Without exception all responses checked Fly-ash.

Little more need be said on this subject. These facts are borne out by every investigation yet conducted and the further use of funds for research work along these lines should be abandoned as utterly unnecessary.

Probably the most important factor in preventing political action toward the abatement of this nuisance comes from influential industrialists who measure prosperity by the volume of smoke emanating from their own and others' chimneys. The majority of politicians, ignorant of nearly everything but the science of the ballot-box, always intercede for a violator, utterly regardless of the public welfare. This intrusion hog-ties any smoke inspector who has a political job and strives to protect it.

How then can the nuisance be abated? To answer this question, I will discuss available fuels in the order of their freedom from smoke and will explain how they can be used and treated positively to banish the nuisance.

Electricity: This source of heat is so far out of the question today on account of prohibitive cost that it cannot be seriously considered; obviously, otherwise it would reduce the smoke problem to few stacks which could be kept free of all nuisance by methods later to be described.

Gas: The same remarks apply to this fuel as to electricity and for this reason it has a limited use. This is unfortunate.

Oil: Fuel oil is fast gaining headway as a heat source for small and large plants, for both low and high-pressure service. However, the emission from the stack of a furnace in which oil is burned is often as black or blacker than the fumes from coal; also the solid discharge may be much nastier as it adheres more easily and is chemically more obnoxious. Hence the use of oil without treatment of the stack emission will not abate the smoke nuisance.

Coal: Ouch! Here is the fuel which has given many men the jitters—both from the standpoint of economic use and smoke. The three universal methods of firing are hand, mechanical stoker and pulverized burner.

There seems to be a thought that hand-fired furnaces are the greatest potential smokers. They may be if improperly stoked; however, if the fires are properly built and replenished they should emit no dense smoke. The unreliable factor is the human element, granting that equipment is of proper size, design and repair.

Mechanical stokers conserve coal if properly installed in a suitable furnace. But they cannot be relied upon to effect smokeless combustion, and furnaces improperly stoker-equipped will produce as much smoke as the furnace fired by hand. Stokers do, or should, effect better combustion than is possible by poor hand firing but as the combustion improves the solid emission increases as I have previously pointed out. Hence stokers too fail dismally to solve the smoke nuisance.

Last is pulverized coal firing. This method may be selected as the best from the standpoint of the emission of black smoke from the furnace stack. The greatest charge against this method, however, is that combustion is so efficient that there is an enormous amount of solids discharged from the stack, and this fact makes the installation of such equipment in a city objectionable from a nuisance standpoint.

Treated coal and coke fall into the same category as stoker-fired and pulverized fuel. This fuel may reduce the smoke emission, but will not reduce the nuisance; the increased solid discharge increases the pollution of air.

My answer to the whole problem is the use of entrapment equipment installed somewhere between the outlet of the furnace and the top of the stack so that a minimum of harmful solids would be freed to the atmosphere. This is the *only* positive method of abating the smoke nuisance. Nothing else will ever do it, and you may as well understand it now. If the installation of such equipment is not made mandatory the expenditure of public funds for the supposed purpose of abating the smoke nuisance in cities is a fraudulent use of taxpayers' money. Funds spent will only protect political jobs.

There seems to be but one method of procedure to accomplish this objective.

The method lies in the passage and enforcement of an ordinance substantially as follows, and which has the endorsement of the engineers in charge of the recent Chicago investigation:

A MODEL SMOKE ABATEMENT ORDINANCE For CITIES and VILLAGES

Be it Ordained by the City of.....
Section 1: That Section.....of the Municipal Code be.....and it is hereby amended to read as follows: (Note: If no ordinance now exists change preamble accordingly.)

SMOKE ABATEMENT

Sec. 1.
Within the corporate limits of the City of.....or within one mile therefrom the emission of smoke from the stack or chimney of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance or incinerator or from the smoke stack or chimney of any building or premises of a density heavier than No. 1 Ringleman Chart measurement is hereby prohibited and any violation may be summarily abated; such abatement may be in addition to the fines hereafter provided.

SOLIDS

Sec. 2.
Also, the emission of solids (soot, cinders, fly-ash, dust, etc.) in excess of 250 grains, by weight (7000 grains to the pound) per 1000 cubic feet of gas discharged from any chimney or stack is hereby declared to be a nuisance and is prohibited and any violation may be summarily abated; such abatement may be in addition to the fines hereafter provided.

NOXIOUS GASES

Sec. 3.
Also, the emission of fumes and noxious gases emitted into the atmosphere from any chimney or stack which is noticeable within 100 feet from any part of the stack or outlet thereof is hereby declared to be a nuisance and is prohibited and any violation may be summarily abated; such abatement may be in addition to the fines hereafter provided.

Sec. 4.
The duty of enforcing these provisions is invested in a Department of Smoke Abatement which is hereby created. This department shall be in charge of a City Smoke Inspector to be appointed by the mayor and with the consent of the City Council. The City Council shall provide for the maintenance of this department.

PERMIT FOR CONSTRUCTION AND REPAIR

Sec. 5.
Hereafter, no new fuel-burning plants shall be constructed or old plants repaired or reconstructed without first obtaining a permit issued by the Smoke Inspector. Plans and specifications for such must be submitted for examination and must conform to standards, rules and regulations fixed by said Smoke Inspector as progress in the art develops. Upon proper examination the Smoke Inspector shall issue such a permit only after he is assured that the plant is designed with provisions for preventing the emission of smoke and abating other nuisances as described in Sections 1, 2 and 3.

(b) Immediately upon installation of the plant it is the duty of the Smoke Inspector or his deputy to examine same and if found to be in compliance with plans and specifications as approved he shall issue a permit to operate same.

(c) The issuance of any permit for construction or reconstruction or repairs or operation shall not be held to exempt any person or corporation to whom issued, from prosecution on account of the emission of smoke or other nuisance as described in foregoing articles, resulting after installation and operation of the plant.

(d) Fees for the examination of plans and the permit and inspection of plants shall be established by the City Council.

(e) A permanent record of all approved plans shall be kept on file in the Department.

Sec. 6.
Plants installed prior to the passage of this Ordinance shall fall within its requirements upon the first violation of the ordinance in effect at the time they were built and first operated.

PENALTIES FOR VIOLATION

Sec. 7.
Any person or persons, firm or corporation, in any way responsible for the violation of any provision of this ordinance, upon conviction thereof shall be fined ten dollars ($10.00) for the first offense; twenty-five dollars ($25.00) for the second offense within-thirty days after the first offense: one hundred dollars $(100.00) for the third offense within thirty days after the second offense. The fourth offense within thirty days thereafter shall exact the penalty of summary abatement.

PROSECUTION

Sec. 8. Prosecution for all violations of this ordinance shall be instituted by the Smoke Inspector and shall be prosecuted in the name of the City of.....
.....

All ordinances or parts of ordinances in conflict with any of the provisions of this ordinance are hereby repealed.

This ordinance shall be in effect from and after its passage, approval and publication according to law.

Compliance with this ordinance will permit the use of any kind of fuel and any method of firing; any amount of smoke could be made in the furnace but it could not escape into the atmosphere without penalty of summary abatement. It would result in the positive elimination of the smoke nuisance.

My critics will raise the cry that such an ordinance cannot be enforced if placed on the statute books. My answer is—where there is a will there is a way. Further, if this is the position authorities are to take, it strengthens my contention that city funds expended for only a gesture at smoke-abatement is public money mis-appropriated.

Unless the public demands the passage of an ordinance substantially as suggested, they can look for no abatement of air-pollution emanating from furnace stacks.

VALVE
INDICATING DEVICES

By G. H. PEARSON

IS THE valve open or closed? In an emergency the engineer wants to be able to answer this question at a glance and not be forced to try the valve to find out. Nevertheless, when certain types of valves are not provided with some sort of indicating device their positions can only be determined by trial.

An indicating device, however, need not be elaborate or cumbersome and should not add appreciably to initial cost. In some power plants it has been the practice to affix metal tallys, usually with the word "shut" in red letters and "open" in green to indicate whether a valve is open or closed. Although this is commendable in many ways, it is a clumsy method and suffers at least one outstanding disadvantage in that it involves the human element. Furthermore, there is always the possibility of misplacing the tally, to say nothing of the time taken to secure it to the handwheel of the valve. Another disadvantage of this system is that valves which may be in a "cracked" position are not so indicated.

Closure indicators can be applied to various types of valves without great cost. Take for example the case of a gate valve, the total travel of the gate being somewhat in excess of the actual bore of the pipe. An indicating device applied to this type valve is shown in Fig. 1. It consists mainly of a thin brass plate attached to one of the two pillars by means of two screws, and suitably engraved. A conspicuous notch or heavily engraved line on a sliding crosshead L for picking out the amount of travel of the valve disk completes the arrangement. The brass plate should not be greater than about 14 B.S.G. since it must be bent to the contour of the valve pillar.

In the case of the globe or angle valve, the vertical movement is only about one-fourth the valve bore. To read the position of the indicator at some distance, therefore, some degree of magnification should be introduced. This may be accomplished by the arrangement shown in Fig. 2, from which it will be seen that use is made of a worm *W* and a worm wheel *H*, proportioned so as to magnify available traverse of the valve spindle and give an indication over half of the dial. This arrangment, however, is somewhat costly and can only be adapted to existing valves by substituting a longer spindle.

It will be appreciated that with a rising-stem valve, the worm, in addition to actual rotation, moves upward or downward as the valve is opened and closed. In consequence, the angular displacement of the pointer will be greater than that due to rotation alone. This should be taken into consideration in determining the relative size of worm and worm wheel and also the length of the worm should be such to provide engagement with the wheel at extremes of travel.

Fig. 3 shows a simpler arrangement, but since the displacement of the pointer is exactly equal to the lift of the valve spindle, which is only about one-quarter of the valve diameter, its position cannot be seen accurately from any appreciable distance. The plate *P* may be made from sheet brass ⅛ in. thick, which is of ample strength to prevent bending. The pointer *R* should be a sliding fit on the spindle and is held in place by collar *C*.

With non-rising valve stems the arrangement shown in Fig. 4 may be adopted. This requires that the spindle be threaded to receive a pointer nut as shown at *N*. It will be found, however, that to obtain a reasonable amount of travel of the pointer between the open and shut position, multiple threads will have to be used, but since these are of V-type their cutting should not be difficult.

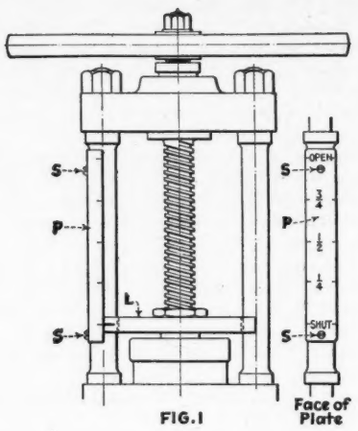


FIG.1

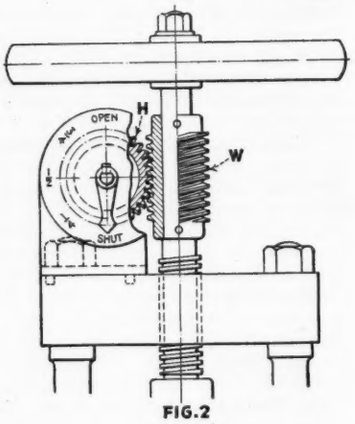


FIG.2

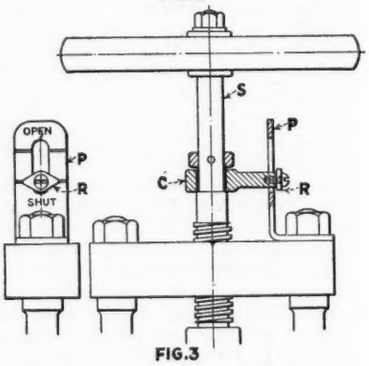


FIG.3

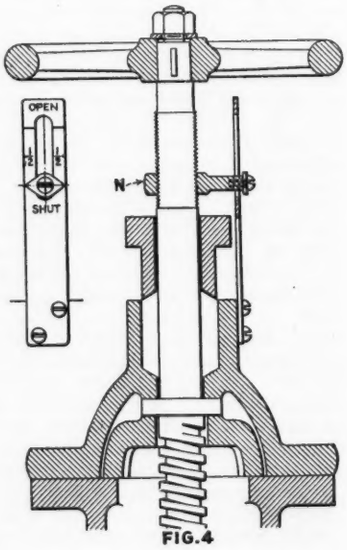


FIG.4

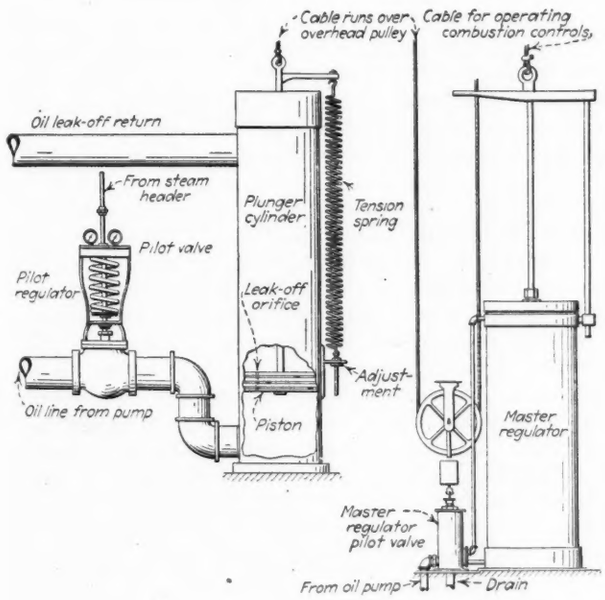
PRACTICAL AIDS TO OPERATION

Three 150-Hp. Motors, Dried After 4-Month Submersion

DURING the revolutionary troubles at Central Cespedes, Cuba, last summer and fall, the men who took over the sugar mill would not permit operators to keep the water pumped out of pits in which were located three 150-hp. motors used to drive the centrifugal injection pumps. As a result, these motors were submerged for 4.5 mo. in dirty water standing 1 to 2 ft. over their tops. The motors had already operated through thirteen crops, and still had their original windings.

The motors were taken apart and dried out in an oven made around the muffler of a 150-hp. diesel engine. After three weeks drying, an insulation resistance of five megohms was obtained. The motors were then varnished, reassembled and put in operation. They ran the full crop without any interruption or sign of trouble. Another insulation test at the end of the run still showed a resistance of five megohms.

Schenectady, N. Y. F. A. STORTZ, JR.
General Electric Co.



Pilot-Valve Regulator Replaces Mercury Column

AN INTERESTING application of a pilot-controlled pressure-regulating valve to an automatic combustion-control system was recently worked out in a large industrial boiler plant. Originally, mercury columns were used as the steam-pressure balancing element, but they did not operate satisfactorily. It was decided to replace these columns with pilot-valve control and retain the remainder of the combustion-control system, as it gave excellent service. The layout of the altered system is shown in the diagram.

A brass cylinder and plunger assembly was available. Two ports were located, one near the top of the cylinder and one at the bottom. The only change necessary was to drill a $\frac{1}{4}$-in. hole through the piston as a leak-off orifice. The lower port on the cylinder received direct oil pressure from the pump at 100 lb. per sq.in. The top port served as a return to the oil-pump suction reservoir. The same oil pump served the plunger cylinder that was previously installed for the regulating system. The eye of the plunger was connected to the master regulator pilot valve to which the mercury float had been connected previously.

In operation, assume that a nearly constant steam pressure of 375 lb. is desired. The load suddenly decreases, and the pressure rises to 378 lb. This increasing pressure in the pilot-valve tube causes the regulating valve to close gradually in proportion to the steam-pressure increase. The spring tension on the plunger rod then causes it to assume a new and lower position according to the oil leak-off through the orifice at the new oil pressure. When the plunger lowers, it moves the master regulator pilot valve, causing this regulator to take a new position. Several major functions may be controlled through this by cable, linkage or electrical connections. These may include fuel feed, forced draft, induced draft and damper position. The type of fuel and fuel-burning equipment determines this arrangement.

Conversely, on a drop in steam pressure, the pilot regulator opens the oil-line regulator and increases the flow of oil to the plunger cylinder. This flow is more than the orifice can accommodate with the existing spring tension, and the oil pressure increases under the plunger and raises it to a new position, determined by the oil flow allowed by the regulating valve.

Cleveland, O. M. E. WAGNER.

A New Grade of Brushes Improves Elevator Operation

IN MODERN automatic-elevator installations with self-landing cars, correct motor and generator commutation may play an important part in successful functioning of the equipment. A large elevator installation of this type had been operating about a year with varying results and requiring excessive maintenance. The cars are required to land level with the floor, regardless of the number of passengers in the car or whether the stop is express or local. Further, the cars are required to repeat this cycle continually and to maintain a definite schedule predetermined by an automatic dispatching system.

Every precaution had been taken to meet all conditions of operation, but complaints of cars not landing level with the floor could not be eliminated. Motor-generator sets were cleaned carefully each night, fairly constant temperature was maintained in the motor rooms, and motor-generator sets were started each morning and run to warm them up before the load came on. Commutation appeared satisfactory, as at no time was there any sparking. Surfaces of the bars were clean, but on a damp or rainy day the cars developed more trouble than usual.

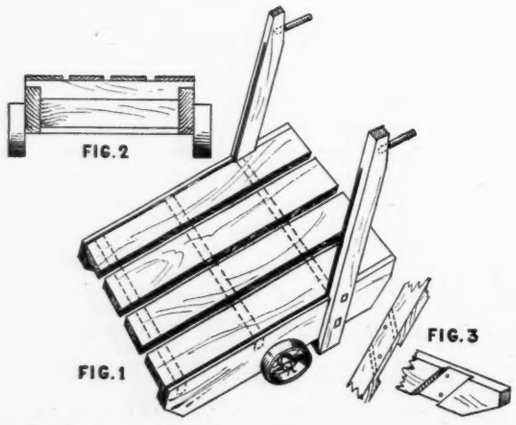
A careful analysis of commutation disclosed that the natural graphite brushes had worn about $\frac{3}{8}$ in. in a year.

This was not an excessive amount, but enough to change the brush-contact surface constantly and produce graphite dust that gathered in the commutator slots in an appreciable quantity during a 4-hr. run. This dust created a high-resistance short around the commutator, causing varying-voltage conditions. Excessive dusting of the brush was caused by high-current rushes, about four times full-load value. This occurred at every start and stop, sometimes every five seconds, due to starting current and to dynamic braking. During dynamic braking the voltage is reversed.

To correct this condition of changing contact drop and dusting, brushes were selected of a grade that would commutate without sparking and would maintain a consistent commutator surface without any appreciable wear or discoloration. They would also carry the high fluctuating current due to starting and dynamic braking, and at the same time have a constant contact drop.

When brushes of this specification were installed, temperatures no longer affected operation. Stability of operation was maintained under all conditions, and instead of mechanics cleaning the machines each day, routine inspection once a month is sufficient. Careful tests disclose that with corrected commutation, the cycle of operation is shortened, the cars make better time (running ahead of schedule), and consuming less power.

Bellerose, N. Y. WILLIAM H. CLINE



This Engineer Builds a Handy Truck

THE TRUCK shown in the diagram will prove itself to be one of the handiest pieces of equipment around the plant. It will take a large bulk load and by using two such trucks, one fore and one aft, the heaviest piece may be conveniently moved. In this way, I have moved everything up to steel girders.

In Fig. 1, the two side runners are made from 2x6-in. boards, with three crossties set down 1 in. into them, as in Fig. 2. The truck deck of $\frac{3}{4}$-in. board stock may be spaced or close nailed. In Fig. 1, 1x$\frac{1}{4}$-in. irons are screwed to the deck planks and up the handles to strengthen the structure. Fig. 3 shows the handles of 2x4-in. material halved into the side runners and bolted. The handle grips consist of $\frac{3}{4}$-in. pipe. They should be roughened with a cold chisel against the pull before being driven in. Ordinary cargo truck wheels are used with the axle extended to the extra width. The axle should be let in flush to the side runners, as in Fig. 2.

Vancouver, B. C. S. H. COOKE.

How to Store Bituminous Coal

LARGE POWER PLANTS have found that the practice of coal storage is a necessary precaution to eliminate the direct effects of supply or delivery difficulties. Labor troubles in mines or transportation systems often cause such conditions.

Three major problems are presented by the storage of bituminous coal. These are the calorific loss, disintegration loss and control of spontaneous combustion.

Loss in heat content through disintegration has been found to be as high as 10 per cent where coal has stood in the open without overhauling for long periods of time. The chemical action that takes place may be described in two distinct steps. First, the pyrites and other inorganics unite with oxygen. Second, the organic matter of the coal oxidizes. The first may cause an increase in volume with a corresponding decrease in weight per cubic foot or a so-called swelling of the coal. The oxidization of the organic matter involves a gradual chemical combustion of carbon, hydrogen and hydrocarbons. This constitutes the most important cause of losses in heating value.

Coal piles seldom remain idle for much more than a year at a time before being handled. Assuming this to be true in most cases, the most important problem to contend with will be the prevention and control of spontaneous ignition. Probably restricted ventilation is the cause of practically all fires in coal piles. Coarse, dry, lumpy coal naturally ventilates itself and requires little or no handling over long periods of time. But with a very fine coal, especially if stored damp, one may be suspicious of possible trouble. Such conditions favor the complete blocking of necessary ventilation, especially if stored in a deep pile.

The greatest practical depth of coal storage depends on two factors; the condition of the coal and the length of time it is to remain untouched. It also, of course, depends on the available head room and the type of coal-handling equipment. As a general rule, a maximum of 6 to 8 ft. for very fine coal, 8 to 10 ft. for average fine coal and up to 15 ft. for coarser coal with lumps may be suggested. These averages are for conditions where the coal is to lie idle for as long as a year at a time.

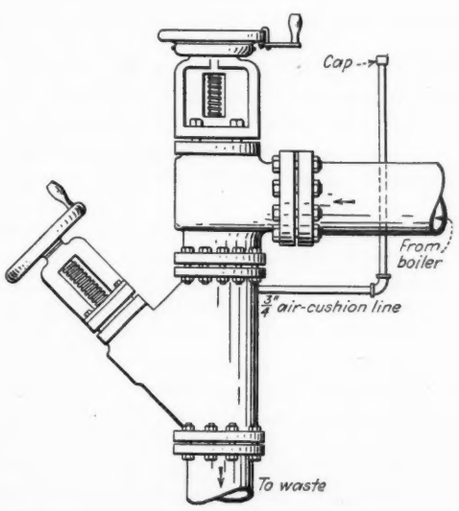
A large New Jersey paper mill recently attempted to store its coal to a depth of nearly 30 ft., due to a favorable market for buying in large quantities. The mill chose the greater height rather than increase the effective operating area of their coal-handling machinery. The coal was unusually fine and much of it had been dampened en route from the mines. After this coal had been stored for several months, fire broke out in several parts of the storage pile. In addition to a number of tons burned, additional expense was incurred in overhauling the entire pile, damage to the bunkers and coal scales from hot coals (which spread the fire to the bunkers), and erratic operation for several weeks due to formation of large clinkers in bunkers and blocking up of coal spouts. This proved to be an unwise and unprofitable experiment.

Probably one of the best methods of detecting undue heating of the coal pile is with thermocouples. A convenient arrangement consists of a thermocouple unit inserted in a 10- or 12-ft. length of pointed $\frac{1}{2}$-in. pipe. A standard galvanometer temperature indicator is con-

nected from the leads at the end of the pipe. The pipe is pushed down into the coal pile in various places for several minutes at a time to take temperature readings. Should a place be found showing a temperature of over 140 deg. F. it should be marked and checked each day to see if it continues to rise. If such is the case, this place should be taken care of.

Once a fire starts, two things must be accomplished as quickly as possible. The center of the fire must be reached and the outside limits determined to stop its spreading. A pointed length of 2½-in. pipe with a number of ½-in. holes drilled in it may be screwed to the end of a fire hose. The pipe may be forced down at the center of the fire where water will be the most effective. This method has been used with much success by the fire department of a large eastern city in combatting such fires at the docks. In large-area, low-level coal piles, the burning section should be isolated by digging around the circumference of the fire limits and care should be taken not to shift any of the hot coal onto other sections of the pile.

Waterville, Me. HARRY M. SPRING



Compression Chamber for Blow-Down Valves

THERE IS a definite procedure in opening and closing tandem-connected blow-down valves. When blowing down, the valve nearest the boiler is opened first. Then the outside valve is opened slowly to control flow. This valve is closed to stop flow. The valve nearest the boiler is then closed. By this practice, the valve farthest from the boiler is subjected to the greatest wear from water and scale. When this wear causes leakage or other trouble, the valve nearest the boiler will usually hold pressure until the outside valve can be repaired, if it is necessary to make the repair with pressure on the boiler.

This practice works very well where the first valve is a quick-opening disk or gate valve. Where two screw-plunger type valves are connected in tandem, the system of operating the valves, just described, may not work with entire satisfaction. Difficulty may be found in closing the valve nearest the boiler, because its plunger comes down on a column of water between it and the closed outside valve.

This difficulty may be avoided by drilling and tapping a hole for a ¾-in. pipe thread in the connection between the two valves. A short length of pipe with a cap is connected in this hole as in the diagram. This line then acts as an air compression chamber to prevent excessive hydraulic pressures between the two valves.

Boston, Mass. A. A. FREDERICKS

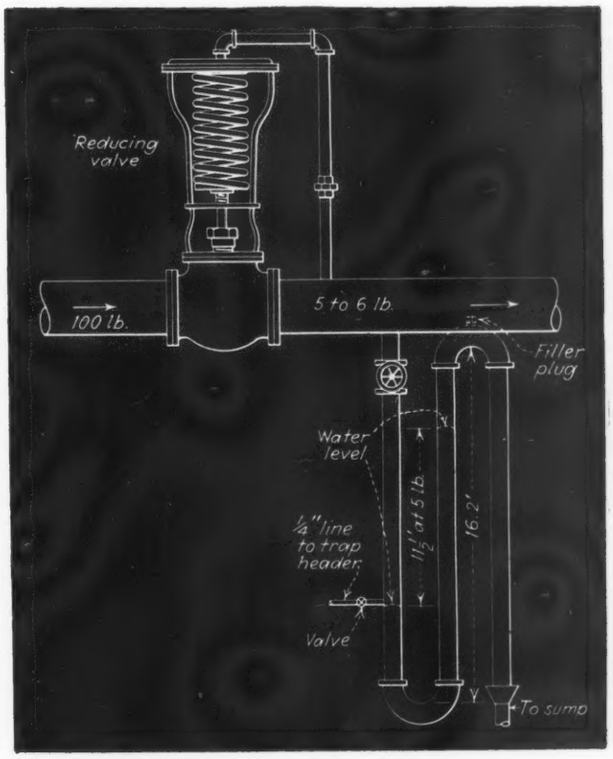
Water Leg Protects Heating Main

A HOSPITAL heated by exhaust steam from engines generating power supplied any deficiency by reducing 100-lb. steam through a reducing valve to 5, the average back pressure carried on the engines. Cast-iron radiators were used, making it necessary to protect them against excess pressure that might build up in the heating main.

A safety valve was not desired, if possible, therefore a water seal, was installed on the heating main as in the diagram. The water leg was constructed for a possible head of about 15 ft. in the riser before the water would spill over and break the seal. This head allowed (16 x 0.434) about 7 lb. per sq. in. maximum pressure in the header. A small drain line was tapped off the lower end of the downcoming pipe line to prevent condensate from filling up to the steam main. This line was connected to a low-pressure trap line receiver, making the water leg also a drip pocket in the steam main.

If the pressure-regulating valve sticks open, as soon as the pressure builds up to 7 lb. the water seal will be forced, allowing free passage for steam to escape. A valve at the top of the downcoming pipe is locked open. A plug is installed at the top of the bend. Should the water leg be blown out, it can be reset by unlocking the valve, closing it and refilling through the plug connection. The key to this valve is kept by the man in charge who sees to it that the valve is open and locked before live steam is allowed to pass the radiators.

Boston, Mass. CHARLES A. ARMSTRONG



CURRENT COMMENT

Vernon Not for Standby

ON PAGE 17 of the January number of *Power* there appears the following statement regarding the Vernon Diesel Plant:

"Some question has arisen about the wisdom of installing such a large diesel plant as that at Vernon, Calif. (*Power*—Nov., 1933), instead of a steam station. It is rumored, however, that Vernon intends eventually to use Boulder Dam power, using its diesel station as standby. Such a situation would distinctly favor the diesel plant."

Please allow me to say that at no time has the City of Vernon considered the use of Boulder Dam power as being desirable for our particular needs. A perusal of the station wiring diagram (*Power*—Nov., 1933) would show that a tie-line connection of this size has not been planned for nor could it be used without a considerable revamping of the layout.

The question of the use of steam turbines or diesels as prime movers had been thoroughly considered before the selection was made, and we now have actual operating experience to show the justification of our selection.

Vernon, Calif. HOWARD MCCURDY
Chief Engineer

Future Compressed-Air Engines

THE remarks of Sanford A. Moss in the May number of *Power*, page 260, referring to the running of Corliss engines with compressed air, are interesting. It is interesting to note that we may again see, within the next two or three years, engines of this type operating with compressed air.

While on this continent we have dabbled with diesel-electric railroad drives during the last few years (the first installation of note being the Canadian National Railway application), Europe has, for several years past, been experimenting not only with the diesel-electric locomotive, but also the diesel-gear locomotive and more recently still, the diesel-compressed-air locomotive.

When the subject of diesel-compressed-air locomotive is first mentioned to the engineer, he is apt to stand aghast at the complexity of this type of drive, the thought immediately entering his mind being that of efficiency. It is well worth pointing out, however, that a well-worked-out diesel-compressed-air installation does not lose very much from the standpoint of efficiency, and at the present development of the art it seems altogether probable that this particular type of diesel locomotive will prove very advantageous for switching purposes. The air receiver, when of ample capacity, can be used for starting and short-switching operations with the diesel idle, while for longer pulls, the diesel engine and air receiver work in unison, the bank of air in the air receiver functioning to handle peak loads.

In the newer European systems heat from the engine exhaust is used for reheating between the air receiver and the air engine, materially adding to the over-all efficiency of the set. In some cases serious consideration has been given to the burning of fuel oil directly in the compressed-air engine, by this means still further increasing efficiency.

If one well versed on the subject takes the necessary time and interest in working out the thermodynamics of the systems outlined above, he is apt to draw the conclusion that the diesel-compressed-air locomotive has advantages that place it in the very front rank of development. In other words, the compressed-air engine may not only be something of the past, but in a modified form, a development of the future.

Sandwich, Ont. BOYD CANDLISH
Consulting Engineer

Paint Versus Bubbles

REFERRING to your article, "Paint Versus Bubbles," in the April number of *Power*, page 207, I wish to relate a little story which may be of interest to those who have read the article.

Some time ago, a certain sales engineer called on me and offered to demonstrate the fact that coating boiler tubes with a graphite compound would increase the steaming rate of the tubes and the efficiency of the boiler. He produced two glass jars very similar to those shown in your photograph, one of which contained a painted piece and the other a bare piece of steel tubing. Jars, heating elements and tubes were alike and interchangeable. The apparatus was set up on my desk and plugged in.

The result was exactly as reported by your own observer. A continuous and uniform stream of small bubbles issued from the coated tube, whereas the bare tube generated much larger bubbles at irregular intervals. To all outward appearances the coated tube was steaming at a faster rate than the bare tube. Still, I remained skeptical of the performance for two reasons:

First—The phenomenon seemed to contradict the well-known fact that a film of paint (or other substance) on a metal surface tends to reduce the rate of heat transfer instead of increasing it. The demonstrator could not supply a convincing explanation of this apparent paradox.

Second—As I observed the jets of steam issuing from the vent pipes of the two jars, it appeared to me that the jar with the bare tube was producing a slightly stronger jet than the other jar.

I proposed, therefore, to check the claims of the demonstrator with an additional test of my own choosing and, with his consent, proceeded as follows:

Both jars were placed on a counter scale with two platforms, borrowed from our laboratory. The jars were filled to exactly the same level with water of the same temperature. Heating elements and cords were attached and the slight difference in gross weight between the two jars balanced out until the pointer of the scale was exactly on zero. The ends of the two cords were plugged into a double socket and attached to one switch. After the current was turned on and the water in the jars allowed to boil for a short time, the scale began to rise on the side which carried the jar with the bare tube, indicating that the water was evaporating faster from this jar. Over a period of fifteen minutes the difference in weight amounted to more than an ounce.

In order to eliminate all possible sources of error, the test was repeated several times with successive inter-

changes of heating elements and tubes and with the jars transferred to the opposite platforms of the scale. Even the connecting cords, although they were of equal length and size, were interchanged to compensate for a possible difference in resistance. Water levels and the balance of gross weights were carefully restored before each test.

The final result was the same in all cases; namely, that the jar containing the bare tube lost weight faster than the jar with the coated tube. This test, conducted before the eyes of the sales engineer, proved to me that the apparently higher rate of steaming produced by the graphite-painted tube is an optical illusion. Painting boiler tubes with graphite paint may have certain other advantages, but the claim of higher steaming rates and efficiencies due to the coating remains to be proved.

Old Bridge, N. J. A. J. LUBELEY
Chief Engineer
Anheuser-Busch, Inc.

A Safe Value for Insulation Resistance

I WAS interested in the answers to the question on safe insulation resistance in the May number and wish to add that experience in testing electrical machines shows that one megohm per each 1,000-volts of rated voltage, regardless of capacity, is a reliable rule. Insulation resistance tests should be made periodically, depending on the voltage, rating and period of idleness. High-voltage and large-capacity machines should be tested monthly. Tests should be made, however, after each extend shut-down.

Stuebenville, O. JOSEPH A. SCHNEIDER.

Found Engine and Shafting Most Economical

THE article "Power Savings Save Old Grain Elevator," in the April number of *Power* calls attention to a good example of modernizing power machinery. In this case the old steam engines were replaced by electric motors and mechanical power-transmission equipment. In one case an investigation proved that the most economical solution to the problem was to retain the steam engine in service.

This plant is driven by shafting belted to an 850-hp. compound engine, in good condition. In addition there is 230 hp. in standby electric motors scattered through the plant, making possible operation of departments when the engine is shut down. A study was made to determne if it would be profitable to motorize the plant completely and to purchase or generate all power.

Tests showed that 211 hp. in mechanical losses could be saved by shutting down the engine and main shafting. In addition 13 hp. in lighting-generator losses could be saved, since this load could be supplied directly from transformers. Also, by better grouping of machines 50,000 hp.-hr. annually in friction losses within departments could be prevented.

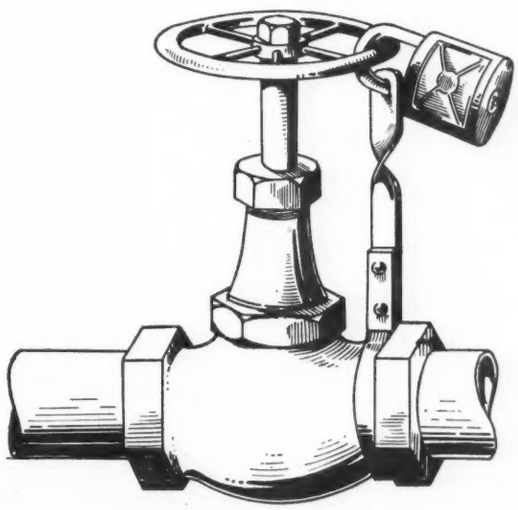
This would reduce the annual power consumption from an equivalent of 3,000,000 to 2,328,000 kw.-hr., a saving of 22.6 per cent. The power could be purchased at $0.01155 per kw.-hr., or $26,900.

On an annual basis, 35 per cent of the steam going to the engine is chargeable to power, the remainder to process and heating. Therefore, shutting down the engine would save 35 per cent of the fuel used in making steam that went through it, a reduction of $10,000. In boiler repairs $920, and in boiler-room labor $1,000 could be saved. An expense of $11,811 would be eliminated in the engine room. With the engine in operation, 575,000 kw.-hr. of power was purchased per year, which could be obtained at a reduction of $1,006 if the engine were shut down. These items total a saving of $24,737 annually that would obtain from shutting down the engine and buying all the power. To do this would require purchasing 330 hp. of additional motors, which would cost $7,900 installed. There would also be $500 investment to supply the lighting power. Fifteen per cent fixed charge on these two expenses would add $1,260 annually to the operating cost if all power was purchased. For this service the total operating cost would be $26,900+$1,260=$28,160, which is $28,160—$24,737 =$3,423 increase in operating expense if the engine is shut down.

Generating all electric power by belting a generator to the engine was also considered. The small saving, about $200, that could be made by doing this would not begin to pay the carrying charges on the investment in generator and additional motors.

The conclusion was that the present system of power transmission by steam engine and shafting is the most economical, and it has been retained.

Worcester, Mass. ALFRED KULLMAN
Research Engineer
The Mechanical Power Engineering Associates



Lock Your Valves For Safety

YOUR contributor S. H. Cooke does well to call attention to the value of locking or making safe exposed valves and valves on lines that are apt to be opened and cause damage or loss of life or property. But if we are to heed the warning, let's be sure that we do not make the mistake of using a hose clamp as suggested, around the neck or bonnet of the valve.

Enclose all exposed valves in such a manner that they cannot be tampered with, any more than a dangerous electric switch. For valves within the plant that require some protection against tampering, I should much rather trust a locking strap attached to the body of the valve or to some structural part nearby than to any delicate affair. I offer the method shown in the diagram as one form of safe locking.

Penacook, N. H. CHARLES H. WILLEY

READERS' PROBLEMS

QUESTIONS for Our Readers

Will Steam-Engine Exhaust Deposit Oil in Heating System?

QUESTION 1

I AM *considering the installation of a steam engine, the exhaust to be used in our steam heating system. I have been told that oil will be carried over with the exhaust steam and deposited in the radiators. The oil decreases the heating capacity of the radiators and may make them unable to heat the building satisfactorily.*

Is this a common difficulty or can it be avoided by proper operation and installation? How can oil in the heating system be removed?—E. R. H.

What to Do When Exciter Fails

QUESTION 2

OUR *motor-driven exciter failed while serving four generators operating in parallel in a hydro-electric plant, and the plant went dead. The generators probably ran at different no-load speeds, but to restore service as quickly as possible, the circuit breaker was opened on the motor-driven exciter and a waterwheel-driven exciter was connected to the bus. The exciter was then started while the main generators were still connected to their bus. When the exciter voltage built up to about 75 per cent normal, the generators pulled into step and service was restored in about 2 min. from the time the trouble started. Have other* POWER *readers had similar troubles and how did they handle them? Can the method I use to parallel the generators be generally applied in such emergencies? If there is a better method what practice should be followed?*—A. A. C.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

How Are Elevator Car Safeties Released?

THE QUESTION *has been raised among some of our men of proper procedure when releasing safeties on our elevator cars in case they are set from overspeed. I would appreciate knowing how this should be done.* J. C.

The way to release safeties on elevator cars depends largely upon the type of safety used. For some types it is only necessary to raise the car a short distance and the safeties will release themselves. In all cases, on a drum-type machine it will be necessary to see that the hoist ropes are not slack before moving the machine with the motor. If the hoist ropes are found to be slack, they also may be misplaced in the drum grooves. In such cases it is necessary first to adjust the hoist rope then slowly take up the slack by moving the machine by hand.

Where wedge-clamp type safeties are used, after strain has been taken on the hoist ropes to support the car, the safeties are released with a tool operated through a hole in the floor of the car. In some cases this tool consists of a gear on a shaft; in others a special type of lever is used. After the safeties are released, the governor cable must again be attached to the carrier on the car and attention given to the over-speed governor to see that it has freed its rope.

How to Rewind 25-Cycle Coil for 60-Cycles

WHAT *changes are necessary in a 230-volt, 25-cycle brake magnet coil to make it operative on 60 cycles at the same voltage? I have not taken the coil apart so that I do not know the number of turns, but the wire is No. 20 size.* R. E. B.

If the voltage remains the same, the number of turns in the coil will have to be changed in inverse ratio to the frequency. Since the frequency has been increased $60 \div 25 = 2.4$ times, the coil turns will have to be decreased in that proportion. For example, if the number of turns in the 25-cycle coil is 1,200, then in the 60-cycle coil the number of turns will have to be reduced to $1{,}200 \div 2.4 = 500$.

The wire on the new coil will have a cross-sectional area of 2.4 times that on the old coil. No. 20 B. & S. wire has a cross-sectional area of 1,022 circ. mils. The new wire will then have $1{,}022 \times 2.4 = 2{,}453$ circ. mils cross-section, or No. 16 wire. If space will permit, it will be well to insulate each layer of winding from the others by one layer of insulating paper. After the coil is wound, it should be dried in a well-ventilated oven for at least 24 hr. Then while hot submerged in insulating varnish and allowed to remain until all signs of air bubbles have disappeared. Then it should be removed and baked until the varnish is hard.

When the brake mechanism is assembled, care should be taken to see that the magnet core closes completely and locks in place. Unless this is done the magnet may not completely close, the reactance in the coil will not be sufficient to reduce the current to a safe value and the coil will burn out.

Rather than rewind the coil you may find it more satisfactory to obtain a new coil directly from the manufacturer.

DUPLEX FEED PUMP GIVES TROUBLE

ANSWERS to April Question 1

THE QUESTION

A DUPLEX *pump is being used in our plant to return condensate to the boilers from a small reservoir to which traps return hot water. The reservoir is about 4 ft. from the pump and the water level stays 5 to 6 ft. below the pump suction. Fireman says the pump was overhauled a year ago and ran fairly well for a time. Now it runs with a jerky motion and does not put much water in the boiler, even after fresh piston packing is put on the water pistons. Perhaps the readers of* POWER *can suggest what has happened to make the pump act in this manner.* C. A. C.

Install Lift Fitting

PRESUMING the piston packing and the valves are in proper condition, the pump action described may be due to an increase in temperature of the water being pumped. If increased water temperature is the cause the water is probably being lifted intermittently due to the formation of vapor. Temperature increase of the water could result from changed operating conditions such as carrying higher steam pressure than formerly, increase in quantity of condensate or to worn-out or imperfectly operating traps.

The preferable remedy would be for the receiver, from which the pump takes its supply, to be located at an elevation which enables the water to run to the pump suction under a positive head.

If the receiver cannot be elevated a remedy which has proved valuable in similar situations may be of service here. The remedy is to reduce slightly the size of the vertical portion of the suction pipe from the receiver, and to install a lift fitting at its top. The suction pipe should, of course, be tight and properly submerged below the surface of the water in

the receiver. Installation of a proper design of foot valve might also be advisable.

D. N. CROSTHWAIT, JR.

Marshalltown, Iowa.

Air Leaks To Blame

THE trouble with C.A.C.'s duplex fuel pump is an air leak in the suction line below the suction valves. This leak will cause the piston to jump, because the water does not enter through the suction valves soon enough to fill the chamber.

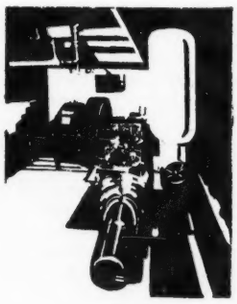
An easy way to find an air leak in the suction line is to use a candle. The flame will be drawn toward the hole. If the leak is small and not at the joints, the line should be painted with a coat of asphalt paint. If the leak is at the joint, the pipes should be uncoupled and screwed together again using graphite pipe grease for a lubricant; if it is a flanged joint a new gasket should be used between the flanges. A new strainer should be used if the old one is worn out. Suction valves should be renewed and adjusted if necessary.

Waynesboro, Va. E. R. KEPLINGER.

Trap Leaks Make Water Too Hot

THAT the pump in question operated satisfactorily for a time after overhauling and then became erratic in operation, so that even with new piston packing it runs with a jerky motion and does not deliver its proper volume of water, points to a condition outside the pump. The water delivered to the reservoir is hot water discharged from traps, and the vertical lift is given as 5 to 6 ft. With allawance for tail-pipe friction, etc., the vacuum on the suction side of the pump must reach 7 in. of mercury.

With 7 in. of vacuum, the theoretical maximum temperature at which water can be pumped is 198.8 deg. However, the practical maximum temperature at which it can be successfully pumped is approximately 160 deg. It is possible that through leaky or faulty traps the temperature of the condensate being pumped has increased above 160 deg., in which case the pump would tend to vapor bind, resulting in the jerky motion and lack of capacity complained of.



If a check of the condensate temperature shows more than 160 deg., trap operation should be checked. If a reduction in temperature cannot be accomplished, or if the higher temperature is desirable for boiler feed purposes, the suction lift should be decreased or eliminated if possible, and the hot water fed to the pump suction under a slight head.

If water temperatures are normal, the following points should be checked: (1) See that the suction pipe is clear and contains no obstruction to prevent the full flow of water to the pump. (2) Check the condition of water end suction and discharge valves, springs and seats. (3) Make sure the proper grade of rubber valve is used for the temperature of the water pumped. Too hard a valve for cool water will cause valve leakage and the troubles complained of. (4) See that the piston packing is properly installed to prevent slippage.

Pottsville, Pa. C. T. REILLY.

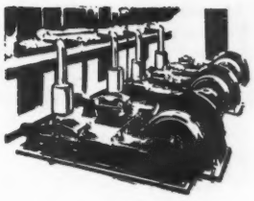
Look for Air Leak in Suction Piping

THAT the pump ran fairly well a year ago after being overhauled indicates internal pump trouble due to leaky valves, etc. That it now runs with a jerky motion indicates an air leak below the suction valves or in the suction piping. Air taken in at this point will cause the piston to jump because the water does not enter through the suction valves soon enough to fill the entire chamber. If this air accumulates between the suction and discharge, and full pressure is on the discharge valves, the air is compressed and expanded by the movement of the plunger, and very little or no water is pumped. Air valves should be provided in the water cylinder to allow this air to escape.

Another trouble which arises in pumping hot water is its tendency to vaporize. As suction lift of a pump increases, the maximum temperature of the water that can be pumped decreases. With the pump in good condition it would be almost impossible to lift water 5 to 6 ft. when at a temperature of 150 deg. F. or above.

I suggest C.A.C. check the mechanical condition of his pump, particularly the valves. Check for air leaks in the suction piping and also the temperature of the water to be pumped. It may be necessary to lower the pump below the level of the water in the reservoir, or as a last resort to lower the temperature of the water to be pumped.

Waynesboro, Va. J. M. MYERS.



Will Not Lift Hot Water

IN PUMPING hot water the tendency of the water to vaporize must be considered. As the suction lift of a pump increases, the maximum water temperature decreases.

Generally, it will be found practically impossible to lift water at a temperature over 150 deg. Hence, where a boiler feed-pump receives its suction supply from an open feed-water heater or reservoir, the water must flow to the pump under a static head.

The inlet head on boiler feed pumps drawing water from open feed-water heaters should, to secure satisfactory service, be from about 1.5 ft. for water at 165 deg. to about 11.5 ft. for water at 210 deg. The pressures due to these heads are necessary to counteract the tendency of pumps to become steam-bound. When a reciprocating pump is in this condition, the piston traverses the cylinder without producing a discharge. The vapor in each end of the cylinder is compressed during one stroke and re-expands during the next, while the boiler-pressure above the delivery valves holds them seated.

If C.A.C. finds it impossible to place the pump so that the feed water will run into it by gravity, he should make sure that the suction pipe is at least one and preferably two sizes larger than the discharge pipe.

A common cause of pumps refusing to work properly is due to air leaking into the suction piping. Small leaks will cause the piston to jump owing to the water not entering through the suction valves soon enough to fill the entire chamber. This trouble may be remedied by making all joints in the suction pipe air-tight.

Hamilton, Ont., Canada.

STEPHEN G. PATERSON

REDUCING VALVE MAKES NOISE

ANSWERS to April Question 2

THE QUESTION

WE HAVE *a 4-in. reducing valve that provides steam at 5-lb. pressure from a 50-lb. main. When in use, this valve makes a singing noise that has become very objectionable. The noise seems to travel along the low-pressure pipe for a considerable distance, so carrying the noise out of the room in which the reducing valves are located. I should like to know what I can do to either stop the noise or make it less objectionable.*

Would a larger or a smaller valve cure the trouble?—A. S. H.

Valve Too Large

NO MENTION has been made regarding the velocity or quantity of steam flowing through this valve, so it is difficult to say just what size valve should be used in this particular case.

Careful attention should be given reducing valve size as the successful operation of the entire system depends on the proper control of reduced pressure.

Excessive noise and leaky valves are usually caused by the valve being too large for the amount of fluid it is required to handle. It should be remembered that a high velocity through a

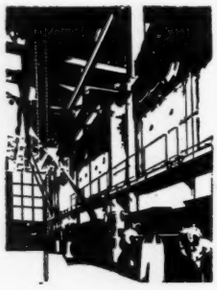
slightly opened valve causes wire-drawing and cuts away the metal of the valve seat.

A regulator should not be selected to handle an extreme peak load that may occur only occasionally over a period of years.

It is better to adjust the setting of the regulator for such conditions. The best service is obtained from a regulator when it is operating near its maximum capacity with the valve well away from its seats.

Judging from the question as stated, the valve is too large, and is working at less than full capacity. The valve being only a short distance from its seat causes the singing noise.

Indianapolis, Ind. M. V. MILLER



Reduce Initial Pressure

THE singing noise is caused by the wire-drawing of the steam through the reducing valve. To eliminate the noise the wire drawing must be eliminated. This may be done in two ways: First, reduce the initial pressure at its source. Second, install a smaller reducing valve.

Either of these changes will cause the reducing valve to open wider to maintain the 5 lb. pressure on the outlet side of the valve and thereby eliminate the wire-drawing and singing.

Cleveland, Ohio. THOMAS C. BROCK

Allowable Velocity 6,000 f.p.m.

THE noise in a pressure-reducing valve is usually the result of the steam passing through a restricted orifice at high velocity.

It is doubtful whether the noise can be entirely eliminated as most reducing valves are noisy to a certain extent. The noise can, however, be minimized to a large extent by using the correct size and design of valve for any particular service.

Reducing valves should be selected on the basis of steam requirements and allowable velocities through the valve, usually taken as 6,000 ft. per min., although in some cases velocities as low as 4,000 ft. per min. are desirable.

A 4-in. valve (I assume this is a diaphragm type of pressure-reducing valve) operating under the pressure condition, 50 to 5 lb. would deliver between 4,000 and 4,500 lb. of steam per hour. The steam requirements should be checked against the steam delivered. If the calculations show that the valve is about the correct size, then a valve one size larger delivering steam at a lower velocity will undoubtedly minimize the noise. However, the same result can be obtained and at less cost by retaining the present valve and installing a Boylston sound diffractor at the outlet of the valve.

Fitchburg, Mass. E. W. SHAFER

Reduce Pressure In Two Stages

THE objectionable noise in this case could probably be lessened by applying some form of insulation to the valve and piping. However, there is little doubt that the real solution of this problem lies in the valve itself. With a reduction of 10 to 1 in pressure and a differential of 45 lb., one must expect a fair amount of noise from a reducing valve.

If the author of this question will install two reducing valves rather than the one, and reduce this pressure in two stages it will no doubt lessen the noise considerably.

Regarding the size of the valve, if one of considerable excess capacity is being used now, one more nearly the capacity of the steam flow would probably reduce the noise also. A large valve only slightly open usually produces an opening of such shape as to cause wire-drawing and quite a whistling noise, while a smaller valve more completely open should permit a smoother flow of steam for the same area of opening.

Beaumont, Texas. R. F. SORRELLS

Use Sound Diffractor

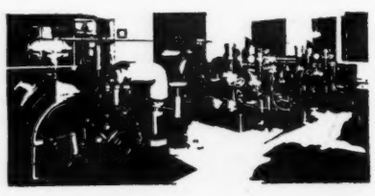
THE singing noise is undoubtedly caused by the flow of steam, assuming that the 4-in. reducing valve is in good mechanical order.

A 4-in. reducing valve with 50 lb. initial pressure and 5 lb. reduced pressure should pass 9,000 lb. of dry saturated steam per hour, depending of course upon the design and construction of the valve. Therefore, I should first ascertain as nearly as possible just how much steam the valve is passing and then inquire of the manufacturer as to the rated and maximum capacity of the valve in question.

It should be borne in mind that some valves are inherent "noisemakers" due to their design.

A 4-in. standard-weight pipe will pass 9,000 lb. of dry saturated steam with a velocity of about 11,500 ft. per min. and a corresponding pressure drop of about 3.6 lb. per hundred feet of pipe. If the reducing valve and pipe line is operating at a load approaching 9,000 lb. per hr. insulated spring hangers are recommended in addition to a muffler or diffractor in the pipe itself.

A commercial diffractor may be purchased, or one may be fabricated by inserting the 4-in. pipe into an 8-in. or larger pipe, capping the 4-in. pipe, and drilling



¼-in. holes in it, making sure that the total area of the ¼-in. holes is ample appreciably to reduce the velocity of the steam flowing. Of course the same thing may be done with other sizes of pipe than those mentioned.

A larger reducing valve would reduce the velocity of the steam through the valve itself and thus might eliminate the noise. However, this is contrary to the average reducing valve manufacturer's recommendation, which usually says that the smallest valve that can be used *safely* should be installed. Furthermore, if that is the trouble—excessively high velocity through the valve—a muffler should eliminate or at least greatly reduce the noise.

In solving this problem I should recommend the following procedure:

1. Check reducing valve carefully for mechanical defects.
2. Inquire of reducing valve manufacturer as to maximum and recommended capacity of the 4-in. reducing valve under actual operating conditions.
3. Check carefully amount of steam flowing through the valve.
4. Ascertain, if possible, whether noise is traveling through piping or building steel, etc., from which piping may be suspended.
5. If reducing valve is handling anywhere near 9,000 lb. of steam per hour:
   a. Insulate hangers
   b. Install muffler; if necessary.
6. If reducing valve is away *under* loaded:
   a. Check with manufacturer as to whether such an operating condition sets up undue vibrations.

Finally, I should proceed very cautiously, especially in spending money, for noise is a very difficult thing to stop and about which little is known. Often a simple thing like a piece of rubber or felt in the "right place" will solve an otherwise aggravating problem.

Boston, Mass. R. M. NEE
Edison Electric Illuminating Co. of Boston.

Install Smaller Valve

THE singing noise caused by your 4-in. reducing valve is due to the valve being much too large for the volume of steam required. The poppet just cracks off the seat, and the steam passing through this small orifice causes the singing noise.

There are several ways to reduce this noise, but first you should find out the minimum, average and maximum amounts of steam which this valve must handle.

First, if the valve has removable and renewable interiors, install a set of reduced area parts, the type and size to be recommended by the valve manufacturer.

Second, install either a new 4-in. valve with reduced area parts or a smaller valve depending, of course, whether the saving in cost of the smaller valve would be more or less than the increased cost of installation.

In any case, you should write to the valve manufacturer giving details of installation. The size of valve, which will be recommended, will probably be much smaller than 4-in. as reducing valve troubles are usually caused by valves being too large rather than too small.

Danvers, Mass. C. W. AVERY

THE ENGINEER'S BOOKSHELF

Boiler Feed

BOILER FEED AND BOILER WATER SOFTENING—A BOILER OPERATOR'S MANUAL. *By H. K. Blanning and A. D. Rich. Published by Nickerson & Collins Co., Chicago. Cloth. 156 pages, 8½x11 in. Formulas, charts and tables. Price $3.*

Because of the dearth of good practical books on the subject of feed-water treatment, this volume should have a ready sale. Its 23 chapters cover in practical fashion, most of the things that are of particular interest to those operators who wish to run their boilers on a scientific basis, particularly in the matter of feed-water testing and treatment. Subjects covered include test equipment, preparation of reagents, sampling water, testing water, symbols for interpreting water tests, interpretation of tests, specifications for treating chemicals, instructions for internal and external treatment, interpretation of external treatment results, control of internal treatment, scale prevention by carbonate-sulphate relation, caustic embrittlement, coagulation, zeolite softening, filtration, boiler scale formation, corrosion, chemical equations, chemical equivalent weights, common name for chemical compounds, miscellaneous notes.

Durable Goods

REPORT TO THE PRESIDENT OF THE UNITED STATES ON NATIONAL RECOVERY AND UNEMPLOYMENT BY THE DURABLE GOODS INDUSTRIES COMMITTEE *(1934). Paper. 97 pages; 9x11 in. Price 20 cents from W. B. Henderson, Secretary of Durable Goods Committee, 310 Bowen Bldg., Washington, D. C.*

America is still in the very midst of the great national problem created by the too-slow upturn of the durable goods industries. This report of the committee manned by George H. Houston and other leading industrialists, points the way to improved business and employment. Its 97 pages prove that increased production of durable goods must be the very heart of a real recovery program and lists the practical steps that must be taken. These, in brief, are as follows:

The sequence of attack must be:

1. First, relief; second, recovery, and third, reform.

2. Of the approximately 9,000,000 now unemployed, nearly 5,000,000 are from the durable goods industries.

3. The key to the unemployment problem is to be found in the stimulation of the construction and other durable goods industries.

4. Reduction in maximum hours has already been carried to the economic limit in durable goods industries under present conditions.

5. The durable goods industries are unable to absorb additional employees or increased costs until the volume of sales is expanded.

6. Among the fundamental conditions needed for recovery are: A free flow of private capital into private business; a sound real estate mortgage market; industrial relations on a basis which will assure cooperation instead of strife; a balanced price parity between agricultural commodities and manufactured goods; the further reestablishment of confidence in Government—most important of all.

Metallurgy

METALLURGY OF IRON AND STEEL (FOURTH EDITION)—*By Bradley Stoughton, professor of metallurgy, Lehigh University. Published by the McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 559 pages, 6x9 in. Indexed and illustrated. Clothboard covers. Price $4.*

This fourth edition is an entirely new manuscript, required partially by developments in the art of metallurgy, partially by the desire to present the subject from the historical standpoint. Power engineers, particularly designers of power equipment, will be interested in these chapters: Mechanical Treatment of Steel (50 pages), Constitution of Steel (23 pages), Heat-Treatment of Steel (46 pages), Constitution of Cast Iron (24 pages), Malleable Cast Iron (19 pages), Alloy Steels and Alloy Cast Irons (41 pages).

Electrical Code

NATIONAL ELECTRICAL CODE HANDBOOK. (2ND EDITION)—*By Arthur L. Abbott. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y., and London, England. Semi-flexible binding 523 pages, 4½x7½ in. Profusely illustrated; many tables. Price $3.*

The National Electrical Code has become the accepted standard for electrical-equipment installation and wiring practices in the United States. This book, based on the 1933 Code, enables the reader to grasp readily the general plan, scope and intent of the Code. It presents a more or less detailed discussion of the rules where something of practical value can be contributed to their application.

The work is divided into five parts: Definitions of the terms used in the code: rules specifying what types of wiring are approved under given conditions; material and apparatus; general requirements applying to all wiring systems; and special cases, which include hazardous locations, theaters, elevators, cranes and hoists and other applications.

The many illustrations of equipments and how they should be installed, tables of wire sizes, instruction for determining feeder sizes, and many other features of practical help make the book a highly useful tool.

BRIEF REVIEWS

SOME RECENT DEVELOPMENTS IN THE ART OF BURNING IOWA COAL. *By John M. Drabelle, M.E., E.E. Reprint of a paper before the Iowa Engineering Society at Iowa State College*—A study of experiences and developments in burning Iowa coal, including drawings of boiler designs.

MUNICIPAL ELECTRIC PLANT MANAGERS. *By Edna C. McMahon, Columbia University. Published by Public Administration Service, Chicago. Publication No. 38. Price $0.60*—A study of the selection, training, salaries and tenure of managers of municipal electric plants, together with a list of municipally owned plants in the United States.

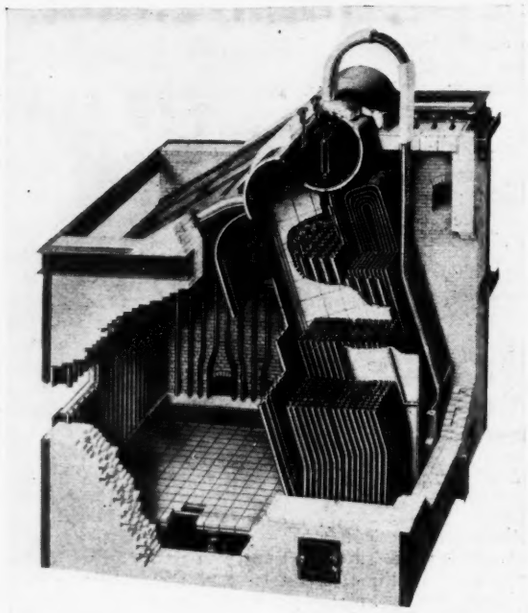
CALCULATION OF HEAT LOSSES THROUGH FURNACE WALLS. *By R. H. Heilman, Mellon Institute of Industrial Research, Pittsburgh, Pa. Technical Bulletin No. 47, dated February, 1934, of the American Refractories Institute*—Describing methods used by the author in calculating heat transmission through insulated furnace walls. Copies may be obtained by addressing S. M. Phelps, Refractories Fellowship, Mellon Institute, Pittsburgh, Pa.

PROCEDURE HANDBOOK OF ARC-WELDING DESIGN AND PRACTICE. *Published by the Lincoln Electric Co., Cleveland, Ohio. Revised and Enlarged Edition, 450 pages, 5¾x9 in. Illustrated. Price $1.50 per copy postpaid in the United States, 50 cents extra for foreign*—A practical guide to anyone interested in welding and a handy reference book for estimators. Chapter headings include: Welding Methods and Equipment, Technique of Welding, Welding Procedure, Speeds and Costs, Structures and Properties of Weld Metal, Weldability of Metals, Designing for Arc Welded Steel.

TENTATIVE METHODS OF TESTING AND TENTATIVE SPECIFICATIONS. *Published by American Society for Testing Materials, Philadelphia, Pa. Price $0.25. Five bulletins.*—Titles of these bulletins are: Tentative Methods of Testing High-Temperature Insulation; Tentative Methods of Testing Rubber Belting used for Power Transmission; Tentative Specifications for Lap-Welded and Seamless Steel Pipe for High-Temperature Service; Tentative Specifications for High Tensile Strength Carbon-Steel Plates for Pressure Vessels (Two bulletins).

EVOLUTION OF LEATHER BELTING. *Issued by Chas. A. Schieren Co., New York. 32 pages, illustrated*—Interesting story of the evolution of leather belting from the ancient Egyptians to modern times.

WHAT'S NEW IN PLANT EQUIPMENT



Integral-Furnace Boiler

B&W boiler unit combines 2-drum boiler, water-cooled furnace, burners for liquid, gaseous or pulverized solid fuels, and, when needed, superheater, economizer and air heater. For industrial use where high nominal ratings with high final steam temperatures and high efficiency are required. Arrangement with inclined tubes entering upper and lower drum lessens headroom required. Water-cooled walls reduce furnace size for pulverized-fuel firing. Side walls stud-tubed, floor water-cooled. Rear wall refractory, cooled by bare water tubes. Slag screen protects boiler tubes and superheater, and is formed from first two rows of boiler tubes offset or staggered and spaced more widely than those behind. Unit for either dry or wet ash removal, dry removal shown. Boiler tubes in three passes, first pass 3½ in. in diameter, in succeeding passes 2 in. Drums fusion welded (or riveted if preferred), lower on cast-iron saddles on footings, upper supported by beams on corner columns. Low draft loss (permitting use of natural draft), flexible in arrangement with auxiliaries, high efficiency due to coordinated design.

Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.

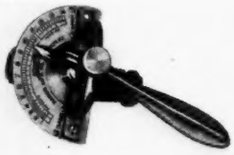
Flexible Coupling

Gear-type flexible couplings now have one-piece sleeve giving closer tolerance at bearing points. Floating sleeve has internal gear at each end meshing with gears on ends of shaft hubs. Runs in oil. Permits free rocking action to compensate for shaft misalignment without binding. Handbook available.

Poole Foundry & Machine Co., Baltimore, Md.

Micro-Regulating Valves

Insure minute regulation of oil to burners, permit duplication of oil valve settings and operating conditions, minimize clogging, save fuel and time. Also for controlling



flow of fluids. Steam connection to hollow cap to prevent solidifying of tarry fuels. Sizes ⅜ to 1-in. pipe, with capacities 0-14 to 0-1300 gal. of light oil per hr., half that for heavier oils. Vernier adjustment if desired.

Hauck Mfg. Co., 126-134 Tenth St., Brooklyn, N. Y.

Smoke Recorder

This photo-cell smoke density recorder is compensated for variations in light source intensity and operated by galvatron electronic relay circuit. Keeps continuous record of relative density on 12-in. chart. Consists of receiving element and recorder which may be mounted on individual boiler panel, and transmitting element consisting of projecting cylinder and detecting cylinder mounted on opposite sides of breeching or flue gas passage. Two photo-cells employed in transmitting element, one in projecting cylinder, other in detecting cylinder. Full luminous flux is received from incandescent light source by compensating cell at all times, regardless of smoke density condition, but photo-cell in detecting cylinder receives light of varying intensities, depending upon density of smoke in passage. Both cells consist of thin metallic disk covered with light-sensitive material which develops a current proportional to intensity of illumination.

Bailey Meter Co., Cleveland,

400-Amp. Welder

400-amp. d.c. welder driven by 25-hp., 230-volt, d.c. motor. Unit frame construction, polarity reversed by thumb switch, bare or coated electrode service.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Testing Ammeters

"Tong-Test" ammeters now available for readings to 800 amp., to 400 for both a.c. and d.c., but larger for one or other. All instruments give readings without interrupting circuit by closing movable tongs around conductor.

Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland.

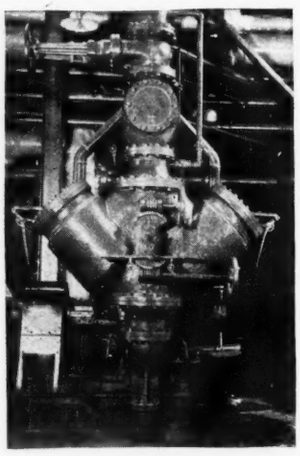
Fuse Pullers & Test Light

Combination tube combines fuse puller and test light. Test pins mounted on handle ends; opening or closing handle adjusts pins to proper distance. Test light inclosed in handle. Reinforced Bakelite, for removing or inserting fuses from 30 to 100-amp. capacity and for testing circuits of from 110 to 500 volts. Over-all length, 7 in.

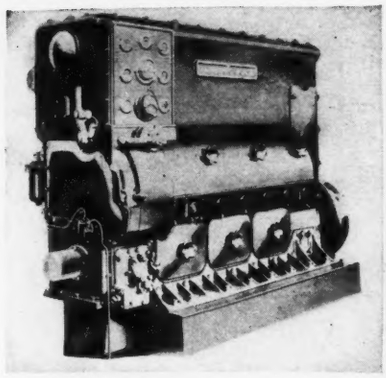
Ideal Commutator Dresser Co., Sycamore, Ill.

Self-Cleaning Strainer

Phillips self-cleaning strainer has back-washing feature to permit cleaning of strainer while in operation and without removing baskets. Comprises two baskets at 90 deg. to each other, flow of liquid being controlled by two swinging gate valves. Strainer baskets are perforated cylinders open at both ends. Water, entering at bottom, divides, half passing through each basket. When one basket is to be cleaned, bottom gate valve is closed, cutting off inlet water. By-pass quick-opening valve on that basket is then opened and closed quickly two or three times to force clean water through strainer in reverse direction, thus flushing d bris through by-pass valve. Swing-gate valve is then reopened. Baskets may be removed for inspection without interrupting service. Illustrated is 12-in. strainer installed vertically at State Line Station, in use for seven months continuously without removing screens. Friction loss 120 in. water or 4.33 lb. when passing 4260 g.p.m.



Henry Pratt Co., 2222 S. Halsted St., Chicago, Ill.



Opposed-Piston Diesel

Light weight, reduced space, feature this 20 lb. per hp. 2-cycle engine. Improved scavenging and greater virtual stroke-bore ratio. Fewer parts, higher rotative and piston speeds. Two short, large-diameter crankshafts with synchronizing connection. Injection timing, pressure and quantity centered in one lever. Idling to full speed in a few revolutions. Elimination of cylinder heads gives better cooling and avoids gaskets. Rigid frame with unstressed parts aluminum. Built-in duplex rotary scavenging blower with uniflow scavenging. Lube-oil, fuel-oil service and transfer, and circulating-water pumps built in. Five cylinder sizes, 5x6, 6½x8, 8x10, 10x12, and 12x15 in., with 6, 7 or 8 cyl., or 5 cyl. in smallest bore. 50 to 300 hp. per cyl., giving engines of 250 to 2,400 hp.

Fairbanks-Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

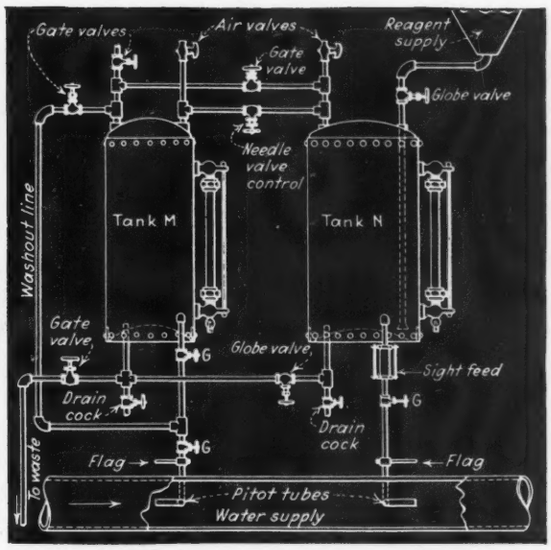
Steam Trap

Float principle and simple, rugged construction for handling condensation. Float seamless copper tested to 500 lb. Powerful leverage to discharge condensate as fast as it enters. Water level maintained high enough to submerge mechanism, thus avoiding wire-drawing and valve hammer. Unaffected by pulsating pressures. Valve seat phosphor bronze, renewable. Valve stem has two-bearing alignment, and is Monel, reversible and renewable.

Nason Mfg. Co., 71 Fulton St., New York, N. Y.

Chemical Proportioning Unit

H-O-H proportioning unit is designed to feed liquid chemicals into liquid lines such as encountered in boiler feedwater treatment. Operation is: Tank *M* is filled with "red oil," a colored mineral base lighter than water and lighter than



reagent in Tank *N*. As water flows through line, a proportionate portion rises into Tank *M*, displacing red oil into Tank *N*, and forcing reagent into line. Percentage injection of chemical is controlled by needle valve setting between two tanks.

D. W. Haering & Co., Inc., 3408 Monroe St., Chicago, Ill.

Automatic Manometer-Regulator

Rugged, simple, permanently accurate. Adaptable to direct and differential pump control, tank level and for maintaining gas pressure and flow between narrow limits. Also for starting and stopping flow in two pipes alternately. Provides visible reading at all times.

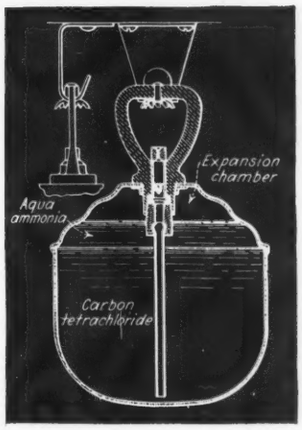
Meriam Co., 1955 West 112th St., Cleveland, Ohio.

Reversible Ratchet Wrench

"Favorite" reversible ratchet wrench handles and heads have been regrouped to avoid awkward combinations and duplications. Old and new handles and heads interchangeable. New

metal with greater strength used for handles, heads and pawls. Wrench works on straight-ahead ratchet movement, with instantaneous reverse by turning pawl. Opening in head allows bolt to pass clear through.

Greene, Tweed & Co., 109 Duane St., New York, N. Y.



Automatic Sprinkler

Chemical sprinkler system for isolated places, etc. "Firetox" units are aluminum with sprinkler head. Melting of fusible plug releases gas blanket five times heavier than air which dilutes oxygen and quenches fire. Non-poisonous. Hermetically sealed.

Firetox System, Inc., Attleboro, Mass.

Plastic Insulating Refractory

"Pire" insulating plastic is adaptable where temperatures do not exceed 2,500 deg. F. Stands up under flame impingement. Light, practically zero expansion, weighs about half ordinary fire brick after burning. Bulletin F 1005.

Chicago Fire Brick Co., 1467 Elston Ave., Chicago, Ill.

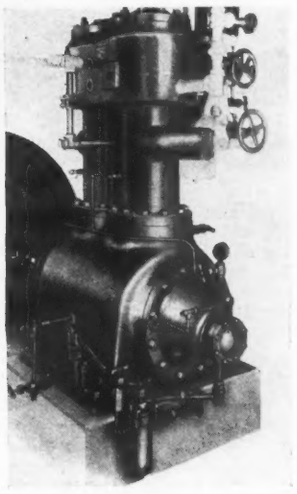
Tannin Brick

Dearborn tannin brick prevents scale wherever water is used as cooling agent—diesel and gas engines, compressors, condensers, open or closed systems. Used in latter where central treating tank is not available. Brick is colloidal reagent tending to keep scale-forming material in solution, combining with calcium and magnesium to form sludge instead of scale. Breaks up old scale. Destroys algae growth and controls corrosion. Briquettes are set in metal basket in system, 1 lb. brick per 1,000 gal. and 1 lb. per 1,000 gal. or makeup in closed systems, 1 lb. per 1,000 gal. in system and 0.1 to 0.5 lb. per 1,000 gal. of makeup in open systems. 2-lb. briquettes, 24 to case.

Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.

Duplex Vertical Ammonia Compressor

Two-cylinder, single-acting unit with strip-plate inertia valves, tapered roller main bearings, automatic forced lubrication, laminated disk oil filter, forged steel shaft and



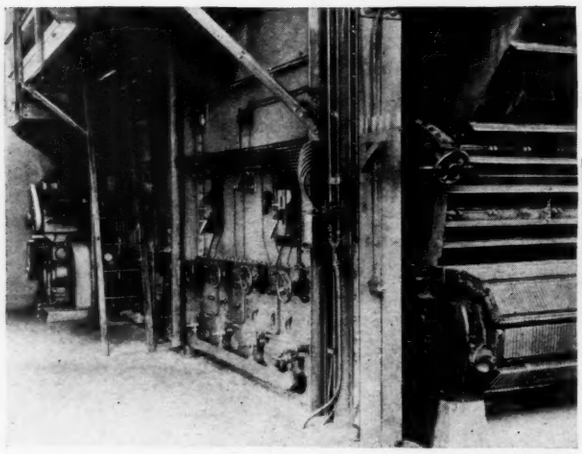
connecting rods, divided housings, one-piece manifold, adjustable oil-gland stuffing box, safety relief valve between discharge and suction. 10x10-in. unit shown; wide range of sizes available.

Carbondale Machine Co., Carbondale, Pa.

Portable Blowers

"Skilsaw" portable electric blowers and suction cleaners now have separate unit for blowing hot and cold air and blowtorch. Ball bearing types. Bulletin.

Skilsaw, Inc., 3310-20 Elston Ave., Chicago, Ill.



Traveling-Grate Stoker

Coxe Design CD stoker is adaptation for wider furnaces, thus larger capacities under forced draft. Employs two or more carrier bars placed end to end instead of a single bar across stoker. Bars carry cast-iron keys of overlapping construction to prevent carrying ash back to front. Structural steel cross members supporting skids and grate surface. Air compartments formed by plates on cross members with steam or air jets to blow siftings into longitudinal trough. Air distributed to compartments from chambers beneath side walls. Handwheels at sides of setting give individual air compartment control. Preheated air may be used. Drive from rear shaft; driving chain take-up at front. Furnace widths 12 to 24 ft.

Combustion Engrg. Co., Inc., 200 Madison Ave., New York, N. Y.

Special Mineral Oils

"Sta-Put" lubricants have been further improved by addition of other hydro-carbons which increase load-carrying capacity. Also increase film strength, thus reducing wear and maintenance.

E. F. Houghton & Co., 240 W. Somerset St., Philadelphia.

Silencer and Air Cleaner

Intake-air silencer and cleaner combined muffles intake noises and filters grit and dust from the air, protecting cylinder walls and pistons. Made in types to fit all kinds of internal-combustion engines.

Burgess Battery Co., Madison, Wis.

Indicating Thermometer Controller

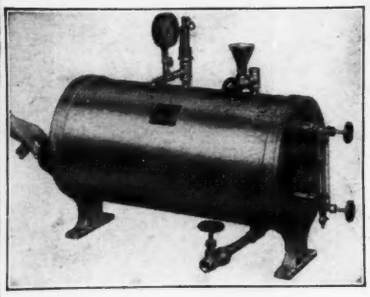
Mercury switches eliminate open contacts. Every 6 sec., motor-driven control table determines position of pointer in reference to control setting and tilts mercury switch from one side to other if temperature has changed. Thus measuring mechanism positions freely. Switch capacities up to 15 amp. at 110 volts or 10 amp. at 220 volts, thus avoiding relays. Adaptable to 1-, 2-, or 3-contact control or signalling systems. 10-in. case. Controls pressure, liquid level, etc. Catalog 6702.

Brown Instrument Co., Philadelphia, Pa.

Metal-Spraying Gun

New "Metalspray" gun is lighter, easier to operate, better balanced and requires less maintenance. Two sizes: Model 126 sprays all metals in ⅛-in. wire, Model 81 all metals in 12-gauge B.&S. wire.

Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif.



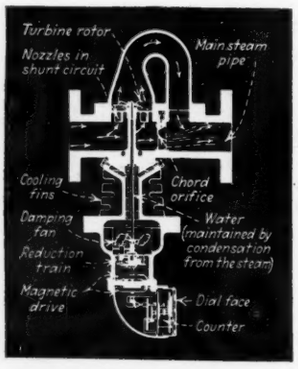
Electric Steam Generators

Electrically-heated steam boilers ranging in capacity from 2 to 18 kw., and generating from 6 to 54 lb. per hr., available for 0-100, 0-200 and 0-300-lb. steam pressure range. May be equipped with automatic pressure control, automatic feedwater regulator, or hand feedwater pump, and low water cutoff. Bulletin 5ZA.

Commonwealth Electric & Mfg. Co., 83-105 Boston St., Boston, Mass.

Shunt Meter

Type KS shunt meter is orifice type for small lines. Meter accurate within plus or minus 2 per cent from rated capacity down to a tenth of that rate, also on temporary overloads to 50 per cent above capacity. Less accurate as air meter or when used as bypass type. No limiting maximum rate. Sizes 2 to 12 in., with four pressure ranges, 0-125, 125-275 (400 deg. F.), 175-250 (400 deg. F.) 250-300 lb. (750 deg. F.). Capacity largest size 39,200 cu.ft. per min.

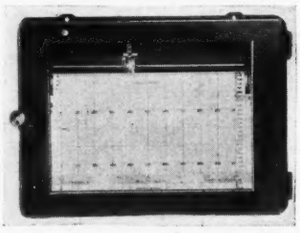


As fluid flows through meter, orifice creates differential causing flow through nozzles into shunt line. This revolves small turbine rotor on vertical shaft with damping fan in water chamber at lower end. Shaft also drives counter train through magnetic drive (to avoid stuffing box). Bulletin 255.

Builders Iron Foundry, Providence, R. I.

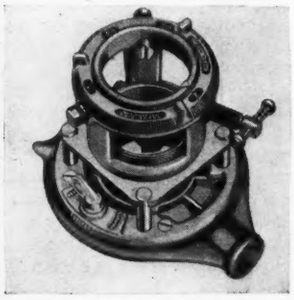
Recording Potentiometer

TAG recording potentiometer is photo-electrically balanced, using new principle in which light beam is reflected by galvanometer upon photocell, resulting current being amplified to close relay. Shutters intermittently operated in front of photocell detect light-beam deflections, and synchronized electric contacts control motion of contact carriage across chart and slide-wire of potentiometer.



Thus latter is electrically balanced and when light beam is at center of shutters, mechanism records carriage position and turns multiple switch to new position. Universal mounting, recording from one to twelve temperatures, any standard chart range (special if required), operates on 110 or 220 volts. Variety of thermocouples. Standard ranges from 0-500 to 0-3000 deg. F. Bulletin.

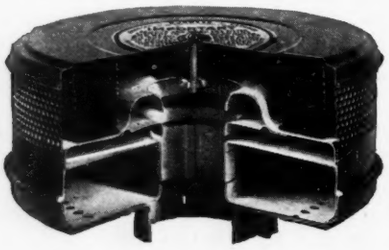
C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.

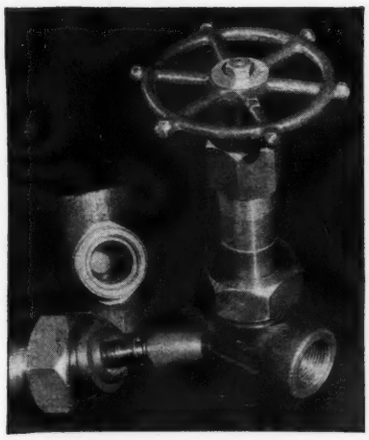


Poster Threader

"Ridgid" poster threader weighs only 12 lb. yet threads 1, 1¼, 1½ and 2-in. pipe. Rust proof throughout. Four sets of chasers, one for each size, but interchangeable. Easily set work holder. Locked-in chasers, ratchet for forward, reverse or locked positions. One or two handles. Special "full floating" design keeps strain from guiding and tapering elements.

Ridge Tool Co., Elyria, Ohio.





Forged Steel Valve

Edward "straight-through" is similar in straight-line flow characteristics to gate valve. Disk is truncated cone swiveling on stem end. Sizes ¼- to 1-in., rated for 2,500 lb. hydraulic pressure at room temperature and 600 lb. wsp at 750 deg. F. Carbon steel, stainless, and 18-8 are standard materials. Inside-screw bonnet.

Edward Valve & Mfg. Co., Inc., East Chicago, Ind.

Semi-Metallic Packing

"Tripplastic" packing includes bearing metal for centrifugal, rotary and reciprocating pumps, plungers, valves, joints, etc., where all-metal floating packing is not practical. In coil form of five sizes. Metal content resists wear and cuts friction. Non-scoring, plastic, and conforms to rod shape. Maintains good lubricating surface constantly. Bulletin.

Wm. B. Merrill & Co., Boston, Mass.

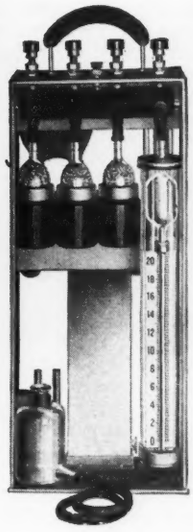
Electrical Metallic Tubing

This conduit reduces wire pulling friction by specially processed (prior to forming and welding) inner surface covered with small raised round knobs. These reduce surface friction as much as 30 per cent. No threading required in installation; cutting and bending easily done. Called "Electrunite Steeltubes"; bulletin.

Electrical Division, Steel and Tubes, Inc., 224 East 131st St., Cleveland, Ohio.

Portable Gas Analyzer

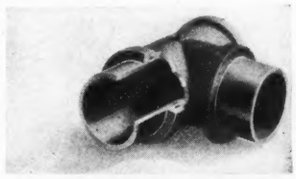
Ellison portable gas analyzer has hard rubber header and seats, new type needle valve with swivel joint, white celluloid scale 7 in. long. Two scale ranges 21% in .2-ml. subdivisions, or 52.5% in .5-ml. subdivisions. Scales, with burette and jacket, interchangeable. All metal parts chromium plated. Complete testing set can be carried in case. Bulletin 20 for details.



Ellison Draft Gage Co., 214 West Kinzie St., Chicago, Ill.

Threadless Bronze Fittings

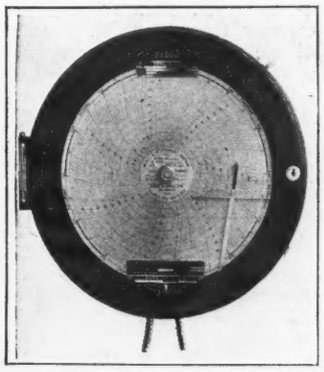
"Walseal" fitting has Sil-Fos rings of brazing alloy in each opening. Pipe is inserted and joint heated with oxy-acetylene flame until brazing alloy flows out and seals joint. Will not clog joint, but has enough alloy for two joinings. Alloy cannot be overheated. Vibration proof, resists corrosion, does not creep. Will not pull apart under any temperature to which copper or bronze can safely be subjected. Made for extra-heavy size pipe. Developed by Air Reduction Sales Co., Walworth Co., and Handy & Harman. To be sold by:



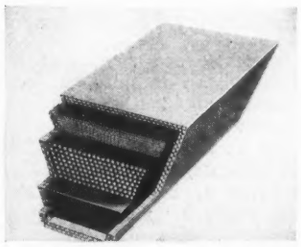
Walworth Co., New York, N. Y.

Electric Flow Meter

MJL "Electruflo" meter has 11-in. scale revolving 270 deg., white figures on black background. Or 12-in. chart with 4-in. pen arc. Ranges from 0-10 to 0-80. Totalizer 5-figure type, synchronous-motor operated. Manometer for any maximum differential pressure between 20 and 200 in. of water; standard unit for pressures to 500 lb. per sq.in. Case cast aluminum. All elements motor-driven. Operates on 110-volt current. Bulletin 28-B1.



Morey & Jones, Ltd., 922 S. Hemlock St., Los Angeles, Calif.



Improved Multi-V Belt

In new Goodrich Multi-V, three layers are balanced to resist stretch and cover wear. Belts are compounded to reduce internal heat.

B. F. Goodrich Rubber Co., Akron, Ohio.

Diaphragm Motor Valve

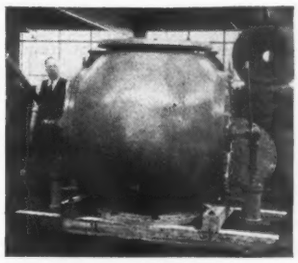
"Synchro" diaphragm motor valve is primarily for use on air-operated control systems. Responds immediately to pressure changes, and stem position for given pressure is same whether stem is rising or falling. No hysteresis or friction loss in top movement. Ample space for renewing stem packing without disturbing adjustments; top may be renewed or spring replaced without changing setting of spring follower. Union and valve bodies of either V-port or single-seated construction with body material and trim as required.

Bristol Co., Waterbury, Conn.

Bearing Bronze

This bearing bronze is semi-finished outside and inside so that dimensions are always full (⅛ extra metal O.D. and I.D. for finishing). Bronze stock in standard 12-, 13- and 14-in. lengths from ½-in. solid up to 8-in. outside diameter, cored up to 2¾-in. diameter. Free of zinc and offers resistance to acid fumes and liquids and caustic solutions.

Magnolia Metal Co., Elizabeth, N. J.



Vertical Exhaust Relief Valve

This 36-in. vertical exhaust relief valve may be completely disassembled without removing body from pipeline, disk being removable through either of duplicate covers on sides. Through cross-shaft with roller bearings and grease-sealed packing boxes carries two internal cranks attached to disk and two external cranks, one attached to hydraulic lifting cylinder, other to oil dashpot. Two counterweighted levers balance disk and hold it open after it leaves seat. Inlet and overflow connections provided. Unit illustrated protects 5,000-kw. turbine at Holyoke (Mass.) municipal plant. Turbine runs condensing with about 28.5 in. of vacuum most of time, except when low water necessitates non-condensing operation at full load. Then counterweights hold disk of valve open, giving full 36-in. pipe area opening without back pressure.

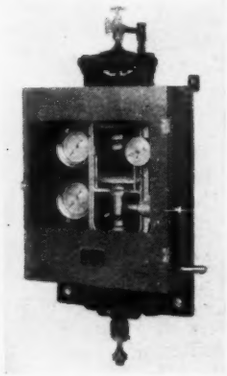
Davis Regulator Co., Chicago, Ill.

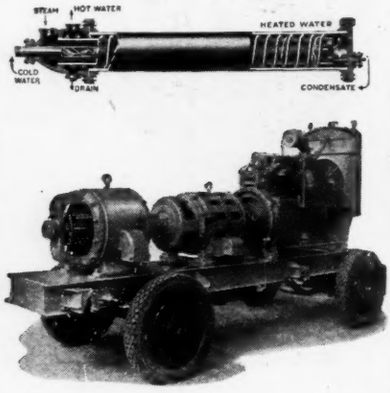
Sealing Compound

Ideal "Perfect Seal" is universal, non-soluble, non-corrosive, and non-oxidizing sealing compound in paste form. Spreads to 0.001 in. Seals oil, steam, gas, water, air, etc. Re-

sists heat up to 400 deg. F. Good rust preventive. 3- or 8-oz. tubes, 4-lb. pails, 45- and 135-lb. drums. Bulletin.

Ideal Commutator Dresser Co., Industrial Division, Park Ave., Sycamore, Ill.





Master Control

Swartwout Type CPQM master control provides accurate pressure control where frequent adjustments are necessary. Consists of pressure regulator with small indicatnig dial and two main pressure gages, all enclosed in tamper-proof case. Removable crank adjusts pressure. Bulletin.

Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio.

Chrome-Base Refractory Cement

Shipped in prepared, ready-to-use form in 250- and 500-lb. metal drums with air-tight, replaceable, full-opening covers. Called "Adachrome." Component materials remain in suspension, and cement is smooth and plastic, free from shortness, and workable even on refractory insulating brick. Air-sets quickly, contains no silicate of soda, gives non-fluxing, non-glazing finish up to 3,335 deg. F. No expansion. Impervious to attack of most slags because of chrome ore base. Can be used with most brick for new construction, repair or patching.

Botfield Refractories Co., Swanson & Clymer Sts., Philadelphia, Pa.

Feed-water Heater

Instant Water Heater consists of concentric steam and water chambers with copper spiral baffle in outer water chamber. Chambers are arranged so that cold water entering heater passes spirally through central chamber full length of heater, surrounded by steam confined in second chamber. Water then returns spirally in a thin sheet along outside wall of steam chamber. Heaters may be secured in 3-, 4- and 5-in. sizes ranging in capacity from 80 to 6,000 gal. of water per hour, using steam up to 150 lb. pressure. Bulletin.

The Johnson Corp., Three Rivers, Mich.

Emergency Power Plant

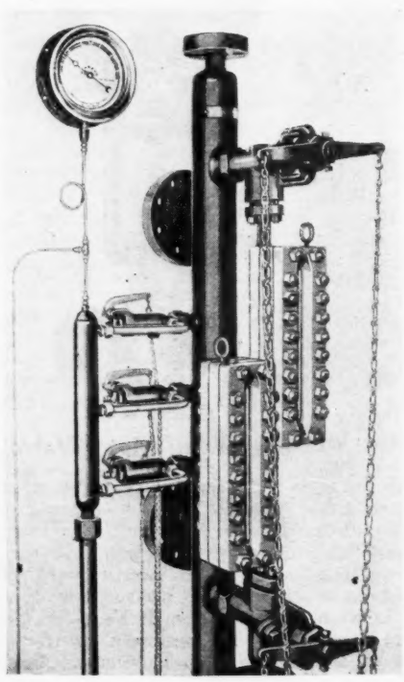
Portable power plant of 50-kw. capacity mounted on pneumatic-tired trucks. Engine-driven generator set furnishes heat at 230 volts d.c. or 230, three-phase, 60-cycle a.c. Either current or both are available for any job up to capacity of driving engine. D.c. unit acts as an exciter for a.c. unit.

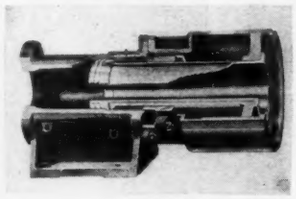
Harnischfeger Corp., Milwaukee, Wis.

Water-Level Detector

"Diamond" water-level detector shows on indicating gage whether water or steam is being discharged from gage cock. Particularly useful for high-pressure boilers. Consists of three quick-opening water-level valves connected to expansion chamber with orifice to control escape from chamber to atmosphere. Indicating gage piped to expansion chamber. Can be applied to existing installations. Bulletin 846.

Diamond Power Specialty Corp., Detroit, Mich.





Piston-Ring Expansion Joint

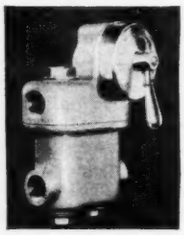
Several improvements, ranges now being 125 lb., 250 lb., and 400 lb. Non-corrosive gland studs and nuts, machined external guide in one piece for two lower ranges, two-piece guide for 400 lb. Enlarged relief chamber from which vent relieves accumulated pressure before gland is removed for addition of packing. Leaflet 234.

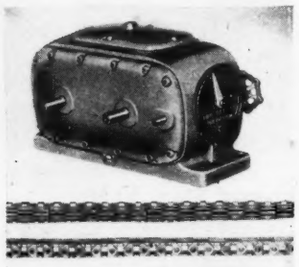
American District Steam Co., North Tonawanda, N. Y.

Controlled Valve

"Stabilflo" valve reverses usual positions of diaphragm and spring. This makes unit more sensitive; suspended construction of diaphragm motor gives smoother valve action. Flexible coupling between motor and valve stem; motor has no guides. Valve-stem lubricator. Flow range 50 to 1 by changes in port design. Open throat of yoke permits free air circulation and protects diaphragm. Chrome-vanadium steel spring enclosed in air-tight pressed-steel chamber to avoid corrosion. Index shows position of valve plunger and indicates whether unit is air-opening or air-closing type. Bulletin.

Foxboro Co., Foxboro, Mass.





Variable-Speed Transmission

Self-adjusting, positive, variable-speed transmission for fractional - horsepower duty called "V.R.D." Horsepower output up to ½ at maximum speed; maximum ratio of speed variation 10-1. All-metal construction, totally enclosed, runs in oil bath, chain transmission. Side-contact roller chain has steel links. Chain design shown. Speed indicator on end; spring pressure maintains tension. Horizontal or vertical box, with or without reduction gearing, with or without integral motor.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.

Manifold Valve

This valve is adaptable to installations where several valves must be located close together. Between reversals, valve disk rotates on two eccentric points while in contact with its seat. Circular lines of contact or scoring do not develop. Disk and seat wear uniformly across full diameter.

Hanna Engineering Works, 1765 Elston Ave., Wicker Park Station, Chicago, Ill.

Water Mixing Valve

No. 904 Fulton Sylphon water mixer is thermostatic type usable either as maximum temperature limiting device in hot-water line and auxiliary mixing valve, or alone to give accurately controlled hot water temperature set manually. Rugged, mechanism entirely mechanical and automatic. If cold water supply fails, mixer shuts off hot water also.

Fulton Sylphon Co., Knoxville, Tenn.

Chain Hoist

Improvements made on spur-geared chain hoist. All exposed parts coated with zinc, making it adaptable for outdoor use or in moist and corrosive atmospheres. Precision ball bearings with integral grease seals supporting all moving parts.

Wright Mfg. Division of American Chain Co., Inc., York, Pa.

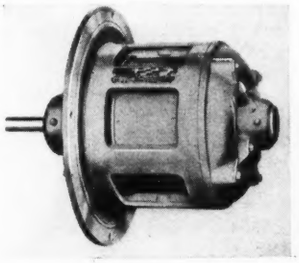
Lead-Covered Pipe

Corrosion-resistant pipe for acid brine equipment, heat-exchanger apparatus and other devices in which corrosive liquids and gases are handled. Standard and special straight lengths of thick- and thin-wall pipe of various metals are protected on outside by a permanently adhering coat of chemically pure lead, antimonious lead, tin-lead or tellurium-lead. Coating may be obtained in any specified thickness.

Gross Engineering Corp., 3955 West 25th St., Cleveland, Ohio.

Flanged Head Motors

This type of mounting is for use where space limitations make it desirable to eliminate motor seat. Particularly applicable to close-coupled pump mountings. Flange is integral



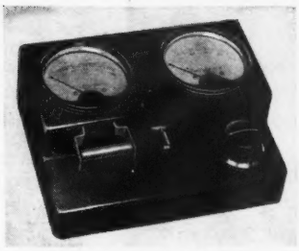
part of motor head and may be finished on either or both sides.

Sales Service Dept., The Louis Allis Co., Milwaukee, Wis.

Surge-Crest Ammeter

This ammeter is for use with magnetic-link method of measuring magnitude and polarity of lightning surge currents in transmission lines and structures. Magnetic-links are small cartridges of magnetic material about size of 1½-in. of lead pencil. Lightning current, passing to or from ground through tower or leg or arm, creates a concentric field which magnetizes link in direct proportion to highest value of surge.

Surge-test ammeter measures degree of magnetization of links, and is combination of two indicating instruments in



series with a flashlight cell and rheostat. One instrument is a milliammeter by which current through combination is read. Other is essentially a milliammeter, but without a magnet, so constructed that magnetized link, when properly inserted, becomes magnet of instrument.

General Electric Co., Schenectady, N. Y.

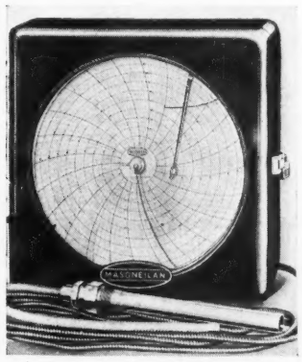
Stainless Steel Chain

For use wherever corrosion is a problem, Diamond roller chains are now obtainable entirely of 18-8 stainless steel—not coated or plated. All commonly used sizes for immediate shipment.

Diamond Chain & Mfg. Co., Indianapolis, Ind.

Recording Thermometer

Instrument furnished in duralumin case with chromium-plated hinges and hasp. May be equipped with over-heat protector, a safety feature that protects thermal element when temperature exceeds range of instrument. Floating coil clamp is said to increase accuracy by

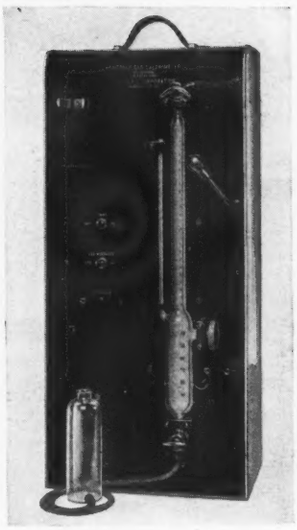


eliminating friction and lost motion. Parts standardized and interchangeable with other Mason-Neilan temperature control instruments.

Mason-Neilan Regulator Co., 1190 Adams St., Boston, Mass.

Gas Calorimeter

Determines heating value of gas in B.t.u. per cu. ft. or in calories per cubic meter. Instrument is portable and requires about 5 min. for first

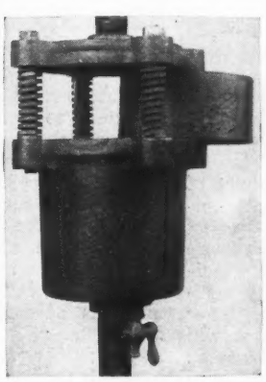


test. Subsequent tests can be completed in from 1 to 2 min. A small sample of gas of from 5 to 25 c.c. is required for determination. Measured gas sample is mixed with air and exploded in a calibrated burette. Heat produced by explosion is absorbed by surrounding liquid which expands and gives reading in calibrated capillary tube. Instrument arranged for parallel tests made on gas of known heating value. This gas, oxygen-hydrogen, is generated in instrument by electrolytic dissociation of water. Since the two gas samples are tested under same conditions, no corrections of any kind are necessary and result is obtained through simple calculation. Bulletin.

The Hays Corp., Michigan City, Ind.

Air Filter

For use in removing oil and condensed moisture from compressed air lines, this Universal

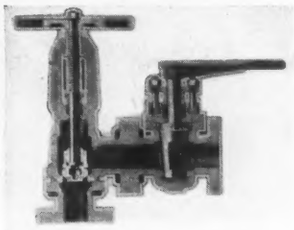


air filter, in addition to large expansion chamber, centrifugal force and baffle, has a manufactured stone as a filter medium. Filter stone is easily replaced with spare units and can then be cleaned with any good oil solvent, such as naphtha, benzene or carbon tetrachloride.

Universal Boiler Filter Corp., 4221 Forest Park Blvd., St. Louis, Mo.

Blow-Off Valve Combination

For use where boiler blow-off occurs frequently, this combination valve consists of Hovalco-angle valve built together with a quarter-turn valve. Latter is



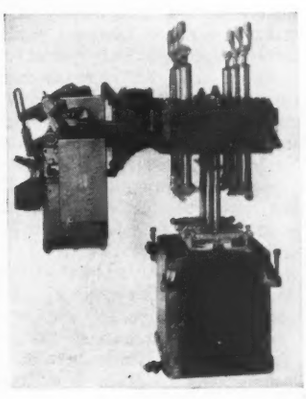
next to boiler and holds pressure so that parts may be renewed on angle valve. Seats of Monel metal, are reversible, making quick repairs possible. Valve combination complies with state codes and A.S.M.E. rulings.

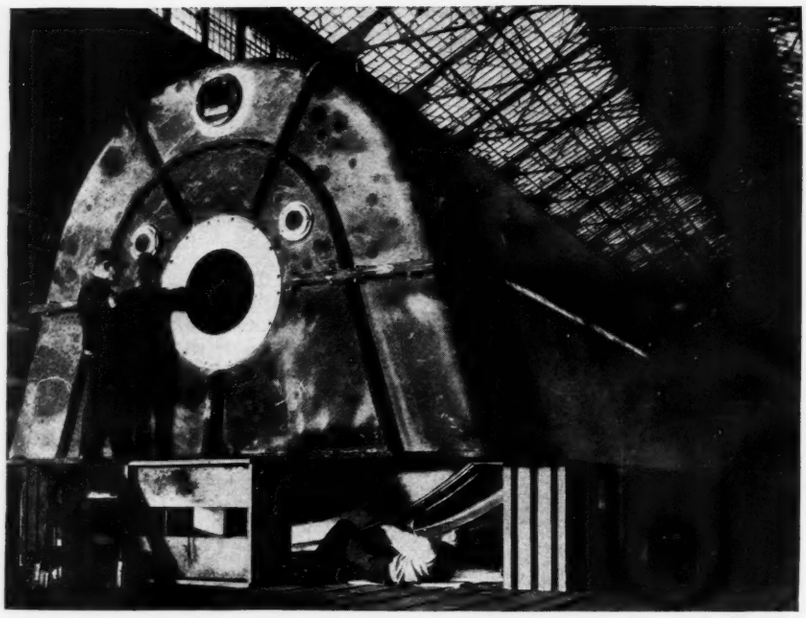
Homestead Valve Mfg. Co., Coraopolis, Pa.

Oil Circuit Breaker

Type ED-20 circuit breaker, built in sizes for 600 amp. at 15,000 volts, 1,200 amp. at 7,500 volts, and 2,000 amp. at 5,000 volts with interrupting capacity of 50,000 kva. All poles in one tank, high-speed inclosed mechanism, rigid-frame construction and deep overhanging flange and provision for standard or reverse frame mounting. Bake-lain bushings in one piece. Brushes laminated and protected by heavy arcing contacts of large thermal absorption capacity. Steel plate tank with full-length lining and barriers between phases.

Condit Electrical Mfg. Corp., Boston, Mass.





Building up the stator at Westinghouse for Philadelphia Electric Company's turbine generator set for Richmond Station on the Delaware River. It will be rated 183,333 kva., 90 per cent power factor, 1800 r.p.m., 3-phase, 60-cycle, 13,800 volts

POWER LINES

Oil & Gas Power Engineers Meet at Penn State

ELEVEN technical papers at five sessions, 150 engineers attending and 30 women, three and a half days of association with others of the same interest —these are statistics of the Seventh Oil & Gas Power meeting at State College, Pa., June 20-23. It was held under joint auspices of the Oil & Gas Power Division and Central Pennsylvania section of the A.S.M.E. and the School of Engineering, Pennsylvania State College.

First of the papers was "Minimum Regular Discharge of Jerk-Pump Fuel Injection Systems," by Theodore B. Hetzel of Penn State. Mr. Hetzel observed that the smallest quantity of oil that the pump could inject without irregularity of any kind increased with an increase in the volume of oil in the injection system and also increased with an increase in the opening pressure of the injection valve. Pressure waves initiated by the pump make it possible to inject a very small quantity regularly at certain speeds, but at some other speeds the minimum regular discharge will be materially greater than that from an ideal system free from such pressure-wave effects. Apparently, the pressure-relief type of check valve permits regular injection of a smaller quantity of oil than the plain check valve.

At the afternoon session, June 20, C. R. Alden described the new Ex-Cell-O fuel pump, which differs from other types in that it makes use of the wabble or swash plate because of its mechanical simplicity. In this design, the tappets have their axes parallel with the driving shaft and are radially disposed around it. The pump shaft carries a central rotary valve in a fuel supply "belt" connected to the plunger cavities. A land on the rotary valve closes each bypass for a certain number of degrees of crankshaft rotation, resulting in equal discharge to each engine cylinder. Changes in properties of the pump are made by changing the rotary valve. Parts are interchangeable, and delivery capacity is altered to suit various engine sizes by changing the swash plate angle. Thus one pump hydraulic unit can be made to serve engine cylinder sizes from 26 to 260 cu. in. piston displacement.

K. W. Connor presented the second paper of the afternoon, "Cylinder Bore Characteristics and the Honing Process." He discussed in turn, cylinder wear, measurements of surface finish, distortion of bores, and new developments in honing, showing the advantages of honing in lessened oil consumption.

Dr. Paul H. Schweitzer of Penn State presented the first paper the following morning, that on "Penetration of Oil Sprays in Dense Air." This is a brief of a report of several years' research soon to be published by the college. Contrary to the general belief that sprays of long duration show greater penetration and higher velocities than short-duration sprays, because the air is gradually set in motion, thus reducing resistance, it was found that there was no noticeable difference between sprays at 50 r.p.m. and 500 r.p.m. Even with the 0.02 sec. injection at 500 r.p.m., this is many times the time required to build up the spray.

Dr. Schweitzer also found that injection pressures affect the spray for only an extremely short time, total penetration being almost independent of injection pressure. Penetration appears to be 15 in. at atmospheric pressure, 9 in. in 100-lb. air, and 6 in. for 200-lb. air on one series of tests. The larger the orifice, the better the spray maintains its velocity and the greater its penetration.

Two other papers were presented at the morning session, both principally of interest to automotive diesel designers and users. These were presented by O. D. Treiber, chief engineer of Hercules Motor Corp., and J. B. Fisher, chief engineer, Waukesha Motor Co.

A paper of general interest, both because of its content and because of its candid frankness was "Diesel-Electric Pipeline Pumping Stations," by L. M. Goldsmith, vice-president, Atlantic Pipe Line Co. This discusses three stations of his company, those at Zavalla, Mt. Enterprise and Silsbee, each consisting of three engines. Silsbee, which Mr. Goldsmith chose as an example, has three Cooper-Bessemer 11½x15-in., 340-hp., solid-injection diesels direct-connected to 400-r.p.m., 225-kw. G.E. flywheel-type alternators with direct-connected exciters. Generators are arranged for parallel operation, and exciters so that one may be used for excitation of all generators or for auxiliary purposes. All station auxiliaries operate on d.c., therefore water pumps, etc., can be operated before generators are synchronized.

A special governor arrangement invented for these installations makes it possible to hold maximum speed variation within 5 per cent, and engines can thus be synchronized without motor-driven controls on the governor.

Fuel is taken directly from the pipeline, and the pumped oil is also used to cool the cooling water of the closed circulating water system.

Last July, a special test was run on lubricating oil consumption. One station has two engines of different manufacture and slightly different design, the important difference being that they have two oil control rings very close to the bottom of the piston skirt, while the newer engines have all oil rings above the wristpins. The tests showed that these 17-month-old Ingersoll-Rand engines averaged 3888 hp.-hr. per gal., while the new engines (after 8 mo. operation) showed 1620 hp.-hr. per gal. Since other conditions were the same, the indications are that oil control rings should be on the bottom of the piston skirt.

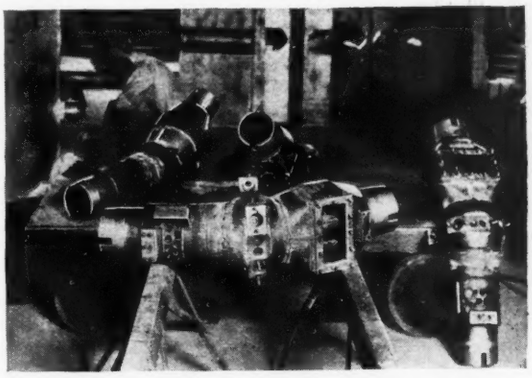
Mr. Goldsmith also showed some interesting results on tests to determine the most economical way to throttle capacity, which must be deleted here because of lack of space. Operating cost per kw.-hr. is 0.0045, total cost he did not disclose, except to say that it was 50 per cent below any power contract offered his company at the time the stations were built.

At the same session, the 1933 diesel cost report was presented by M. J. Reed, secre-

tary of the committee. Copies of it may be obtained from the A.S.M.E. at 29 West 39th St., New York, N. Y.

"Oil Country Prime Movers and Driven Machines" was the subject of a movie shown at the banquet that evening by R. W. Rogers, chief engineer of Joseph Reid Gas Engine Co. There was also a short film shown by J. A. Spanogle demonstrating by means of ultra-fast pictures what happens in a combustion chamber during injection and burning of the fuel charge. These highly interesting pictures are to be included in a forthcoming report of the National Advisory Committee for Aeronautics.

At the Saturday morning session, two papers were presented, "Recent Developments in Diesel Engine Fuel Testing," by T. B. Rendel, and "Wear of Piston Rings and Liners Influenced by Piston Ring Design," by W. G. Godron. The first explained new instruments developed by oil companies for testing diesel fuels, and prompted some interesting discussion regarding combustion products and how they leave the cylinder.



First Arc-Welded Diesel Cylinders

F. B. Stearns, Cleveland, Ohio, is building an experimental diesel embodying arc-welded cylinders. Arc-welded steel is being used for the cylinders and other parts. The cylinders illustrated are for a 320-hp. diesel operating at 1,300-r.p.m. Some 16 pieces are required for each cylinder. Welding was done by Thornton Co., with Lincoln equipment

Heating Engineers Enjoy Poconos At Semi-Annual Meeting

IN THE beautiful Pocono Mountains, the American Society of Heating and Ventilating Engineers held its semi-annual meeting at Buck Hill Falls Inn, Pa., June 19 to 22.

Two features of the program were addresses: "Examining the Construction Recovery Program," by Col. Chevalier, vice-president of the McGraw-Hill Publishing Co., who spoke instead of Malcolm Muir, president of the same company, and a second address by Thomas S. Holden, vice-president of F. W. Dodge Co. on the "Reemployment of the Construction Industry."

Of particular interest at the first technical session were two companion papers. The first, "Influence of Stack Effect on Heat Loss in Tall Buildings," by Axel Marin, was presented by J. H. Walker of Detroit. It described tests made in the 47-story Penobscot Building there which compared the heat loss from three almost identical rooms on the 8th, 21st and 32nd floors.

Test rooms and surrounding rooms were maintained at constant temperature, and condensate from the radiators in test rooms weighed. This gave the heat supplied to the room, and since temperatures were held constant it represents heat loss. It was found that the amount of heat necessary to heat the 32nd floor room was about 40 per cent less than that required to heat the 8th floor room after corrections were made for exposed wall and glass.

In the other paper, F. C. Houghton presented the results of observations of wind velocities made three feet outside of eight rooms of the 40-story Grant Building in Pittsburgh. Three of these rooms were on the 7th floor, one on the 18th and four on the 27th floor.

In all cases it was found that the average wind velocity 3 ft. outside the room windows was considerably less than that recorded at the Weather Bureau, still at certain windows, depending on wind direction, occasional high velocities were found.

Averages for all tests showed the heat flow calculated from the observed temperatures and wind velocities outside the window to be 83.6 per cent, and the heat flow calculated from the inside film conductance coefficient to be 75.4 per cent of that based upon Weather Bureau observations.

In discussion, Mr. Walker pointed out that while refinements of 1 or 2 per cent were not necessary in calculating heating surfaces, the need for still greater refinement is indicated by the fact that many of the radiators in the Penobscot Building were not large enough, while others were too large.

A. E. Beal, in a paper, "Dry Bulb vs. Effective Temperature Control," advocated maintaining an inside effective temperature halfway between 71 deg. effective temperature and the outside effective temperature.

Carrier and Fleisher objected in discussion to many of the statements as being contrary to their experience. Mr. Carrier, however, agreed that effective temperature was not used as much as it should be.

The Thursday morning meeting was held jointly with the American Society of Refrigerating Engineers, which was holding its semi-annual meeting at Skytop, Pa. There were two papers sponsored by the Refrigerating Engineers, "Water Vapor Centrifugal Compressors," by Paul Bancel, and "Electric Rate-Making for Small Air-Conditioning Units," by G. W. McLenegan. Mr. Bancel described and gave the characteristics of a centrifugal compressor developed for water-vapor refrigeration. This compressor and its characteristics were described in the February number of *Power*. Mr. McLenegan deviated from the published title in that he discussed voltage variations and light flickering due to current consumption during the starting period of residence refrigerating systems.

The two papers sponsored by the Heating & Ventilating Engineers were, "Operating Results of an Air-Conditioning System Compared with Design Figures," by J. R. Hertzler, and "What is the Cooling Load Factor in Air Conditioning," by John Everetts, Jr.

The paper by Mr. Hertzler described the air-conditioning system installed in the Union Dime Savings Bank in the spring of 1932. The bank had previously been ventilated with a supply and exhaust system, the ducts of which were largely utilized in the new air-conditioning system. The main banking room has a ceiling 47½ ft. high. Only the lower portion of this high ceiling room needed to be cooled during the summer. The author showed how this was accomplished and the reduction in refrigerating load obtained by allowing the upper portion to remain hot.

The cost of operating the air-conditioning and heating system of this building, after the air-conditioning system was installed, was reported as $200 less than in previous years. Because the old supply and exhaust system of ventilation was shut down, the power cost for air conditioning was only $78.56 more than that during the previous year. The installation of air washers with facilities for additional cleansing of the air permitted greater recirculation during the winter. Because of the small amount of outside air used, a steam saving of about 25 per cent was made.

Mr. Everetts, in his paper, presented a method for estimating the refrigerating load factor in air-conditioning units from a tabulation of dry and wet bulb readings during June to September, inclusive, for the period 1925 to 1931. Application of this data was shown in two examples, one in an industrial plant in New York City, the other in a department store. Load factors worked out in these two cases were 31.5 per cent and 50.5 per cent.

The papers presented at the Friday morning session all reported the result of University researches conducted in co-operation with the A.S.H.V.E. Research Laboratories. These included "The Insulating Value of Bright Metallic Surfaces," by F. P. Rowley, "Steam Transfer from Direct and Extended Surfaces with Forced Air Circulation," by G. L. Tuve and G. A. McKeeman, and "Factors Affecting the Heat Output of a Convector," by A. P. Kratz, M. K. Fahnestock and E. L. Broderick.

N.E.L.A. Hydraulic Power Committee Holds Reunion Meeting

Seventy members and their friends afforded 3-day opportunity to obtain first-hand information on a wide range of practical problems in hydro-electric plant design and operation.

AT LANCASTER, Safe Harbor and Holtwood, Pa., May 27 to 29, there was held a reunion of the Hydraulic Power Committee of the former National Electric Light Association. This meeting was one of the most successful in the long and active history of the committee. In point of opportunity to gain first-hand practical information upon design and operating problems, the meeting was probably without parallel in the history of power engineering.

Four technical sessions were held and two half-days were spent on what might be better called an intensive, practical study course in hydro-electric and steam-plant operation at the plants of the Safe Harbor Water Power Corporation and the Pennsylvania Water & Power Company. The excellent way in which these trips were organized, the opportunity afforded to get first-hand information both by written and oral instruction, and the wide variety of advances in water-power engineering presented placed them in a class far in advance of the usual plant inspection trips, valuable as many of these are.

The meeting opened Sunday morning with a trip through Safe Harbor plant, on the Susquehanna River about 10 mi. from Lancaster, Pa. This plant has five 42,500-hp. Kaplan turbines in operation. A sixth is being installed this year and the plant is planned for a total of twelve units, making the ultimate capacity 510,000 hp. These turbines are the world's highest powered Kaplan units and the only large Kaplan type in this country. Because of this, it is only natural that many problems were involved in their design and operation.

In addition to a general inspection of the plant in operation, opportunity was afforded to see the equipment for the two-type current-meter method of water measurement developed to test the Safe Harbor units; and the Winter-Kennedy system of differential pressure taps in the scroll case walls, used to operate flow meters to give a continuous record of water used by the turbines. A wheel casing was open so that the stainless-steel welding of pitted areas on the blades and other parts could be inspected. The equipment for doing the job was also available for study.

A method of applying the oscillograph to obtain simultaneous records of instantaneous frequency variation and of governor action was demonstrated, along with improvements that have been made in governors as a result of these studies. An interesting exhibit of packing was made available, showing how main unit packing problems had been successfully solved.

At each of the exhibits a representative of the engineering, test, or operating departments was in attendance to demonstrate and give expert information. The practical value of this inspection trip alone far more than justified the meeting. For further details regarding operation at Safe Harbor, see the article on pages 365 to 367 in this number.

The first technical session was held at Safe Harbor plant Sunday afternoon, with Carroll F. Merriam presiding. The meeting was opened by presentation of a trophy to Byron E. White, by Ely C. Hutchinson and Prof. C. M. Allen, for his untiring efforts and constructive leadership as chairman of the N.E.L.A. Hydraulic Power Committee for the five years, 1927 to 1932.

J. A. Walls, President of the Safe Harbor Water Power Corporation, as well as of the Pennsylvania Water & Power Company, welcomed the members of the committee and their friends and expressed his appreciation of the many contributions made by members of the Hydraulic Power Committee and their companies to the design and operation of the Safe Harbor plant. He said that what had been accomplished at Safe Harbor was not the work of any one man, but that of many men in many companies, and the Hydraulic Power Committee with Byron E. White its leading inspiration.

J. B. Cutler talked on the mechanical design of the turbines, told of troubles experienced in this part of the equipment and how they were successfully corrected. The successful welding of pitted areas on the turbine blades with stainless steel attracted an unusual amount of attention, first, because the metal has resisted severe cavitation for nearly nine months without any indications of pitting, and, second, the method used in doing the work. How the work was done and the packing troubles corrected were subjects of an interesting talk by P. M. Hess, station superintendent.

A continuation report of the subcommittee on governors, with particular reference to governor-operating experience at Safe Harbor, was presented by E. B. Strowger, Buffalo, Niagara, and Eastern Power Corp. This report covered improved test methods, the use of figures of Leaute, Safe-Harbor governors, inertia compensation, special equalizing cam, air injection into the turbines, flexible load limit, adjustable-blade propeller units with adjustment made by water, and modern improvements applied to old governors. All of these features were subject for interesting and practical discussion. For further details see the article previously mentioned.

At the Monday morning session, held at the Stevens Hotel in Lancaster, O. C. Merrill, chairman, American Committee of the World Power Conference, outlined the work being done in Europe to establish a unit of pipe roughness and told about efforts made in the United States to get similar work started that would be coordinated with European research. He said that research would probably be undertaken in this country if a suitable laboratory could be found.

Norman R. Gibson, chief engineer, Buffalo, Niagara and Eastern Power Corp. introduced the discussion on methods of water measurement. He expressed the opinion that, when plotting up the results of the waterwheel tests, curves should first be plotted of discharge and horsepower against gate opening. Any irregularities in the test results would probably be indicated on these two curves. A third curve derived from these two should be plotted for efficiency, and then finally the efficiency points can be plotted. In all cases the values obtained by test should be indicated on the curves so that any deviation from the curves may be known. This opinion was concurred in by others taking part in the discussion.

Ely C. Hutchinson, chairman of the A.S.M.E. Hydraulic Power Test Code Committee, told of work being done by his committee. He said the committee was working hard, was making progress, and expected to have a code ready for the first printing next winter when it would be submitted to the industry for suggestions and criticism.

Considerable attention was given to the current-meter and other methods used to measure water at Safe Harbor, with J. M. Mousson their leading expounder. These have been covered in the article on pages 365 to 367 in this number.

A progress report was made by Ernst Spannhake on the fundamental research being done on cavitation at the Massachusetts Institute of Technology. This report was supplemented by an exhibit of test plates for examination under a microscope and experiments with rubber and rubber paint at Safe Harbor and Holtwood plants.

Tuesday morning session was held in the club house of the Pennsylvania Water & Power Co. at Holtwood. Work on cavitation being done in the Holtwood Laboratory and Safe Harbor plant was discussed and examples of pitting by cavitation on metals exhibited. In the afternoon, the Holtwood laboratory was inspected and demonstrations given of how cavitation is produced, provision being made so that water flow through the model runner could be watched under various operating conditions. The high-pressure cavitation test stand, using water at velocities up to 265 ft. per sec., was open for inspection and specimens tested under these conditions were exhibited. Other features of the afternoon inspection trip were the Holtwood steam and hydro plants and the river-coal preparation plant. The program closed with everyone expressing his deep appreciation to the executives and engineers of the Pennsylvania Water & Power Company and the Safe Harbor Water Power Corporation for their efforts that made the meeting the most interesting and helpful in the history of the Hydraulic Power Committee.

Boulder Dam Work Two Years Ahead

Boulder Dam is two years ahead of its construction schedule, partially as a result of operations this year under a PWA allotment of $38,000,000. Up to date about half of the total of 3,400,000 cu.yd. of mass concrete is in place. At the time of letting the construction contract the tentative program called for completion of the concrete placing in August, 1937. If present progress continues, this feature of the work will be completed by May 1, 1935, or two years and three months in advance of the date originally contemplated. It appears now that storage of water in the Boulder Dam reservoir will possibly start the latter part of this summer. This also is approximately 2 years ahead of the time set in the tentative construction program.

The Reclamation Bureau has recently awarded contracts to five California and Utah mills, for 1,000,000 barrels of cement which will cost $3,365,000. During the next few months contracts will be awarded for a large amount of electrical equipment for the power plant.

Westinghouse Builds Boiler Plant at East Pittsburgh

The Westinghouse Company has commenced construction on a new boiler house for plant process and heating purposes at the East Pittsburgh works. A feature will be the entirely arc-welded construction of the new building to house the boiler which will be erected on the site of one of the present boiler plants.

Present plans provide for erection of a building having five of an ultimate of eleven bays and installation of one boiler at a total cost of about $400,000. This first installation, which replaces six boilers of the present plant, is one of four new boilers which will ultimately replace the 24 units now in use.

The new boiler, a 16,000-sq.ft. unit, will produce 150,000 lb. of steam an hour and is capable of operation at pressures up to 600 lb. Each new boiler installed will have a 450-ton coal bunker, full automatic coal-handling equipment, link-grate underfeed stokers, ash evacuators, forced- and induced-draft fans, combustion control and unit stacks.

Chrysler Builds Boiler Plant In Four Months

What probably constitutes a record in the speed of designing and constructing a large boiler plant is the installation at the Newcastle, Ind., works of Chrysler Corp. Faced with the necessity of adequate and economical steam production to meet the spring demand for cars, the company, early in October decided that it would be necessary to install a new boiler plant of two steam-generating units with their appurtenances. Oct. 21, the consulting engineers, Thomas E. Murray, Inc., were told to proceed with the necessary plans and specifications for both building and equipment. Oct. 23, specifications for the boilers, furnaces, fuel-burning equipment and air heaters were sent out for bids. Oct. 28, this contract was let to Combustion Engrg. Co. Nov. 11, the steel contract was let, the first shipment arriving about the middle of December. The first boiler was shipped Dec. 12, and was supplying steam Feb. 28, exactly four months from the letting of the contract. The second unit was ready about two weeks later.

The new boiler plant consists of two 140,000-lb. per hr. bent-tube boilers, having fin-tube water walls and direct fired with impact-type mills. A vacuum system of ash removal, full combustion control and a feedwater treatment system is part of the installation. The entire plant is housed in a new building, 110 ft. long, 70 ft. wide and 60 ft. high, surmounted by an 80-ft. steel stack.

Engineers Use New Plan To Find Jobs

Metropolitan Section, A.S.M.E., is using a new plan to find jobs for unemployed engineers. Salesmen employed by marketing and manufacturing concerns who make a number of contacts each day with all lines of industry are being engaged to make contacts with likely employers.

Bonneville to Have 60,000-Hp. Kaplan Turbines

Proposals for two 60,000-hp. Kaplan turbines and their governing equipment for the Bonneville development will be received by the War Department, District Engineer's Office, Portland, Ore., until July 18. These turbines will have about 30 per cent greater capacity than any of the Kaplan type now in operation. Under a rated head of 50 ft. and full load, these units will have a discharge of 12,000 sec-ft. Effective head will vary from about 65 to 30 ft. At the latter head the turbines will be expected to develop at least 28,000 hp. Above 50-ft. head, gate opening will be limited so that at no time can a turbine deliver more than 60,000 hp. to its generator shaft. The turbines will operate at 75 r.p.m., and will be directly coupled to 48,000-kva., 90 per cent power factor generators.

Bonneville Dam site is on the Columbia River, 40 mi. east of Portland, Ore. The plant is laid out for an ultimate of 10 to 12 units. Two are to be installed initially and a partial substructure provided for four more. Space is to be allowed for a later extension of the structure to provide for four to six more units.

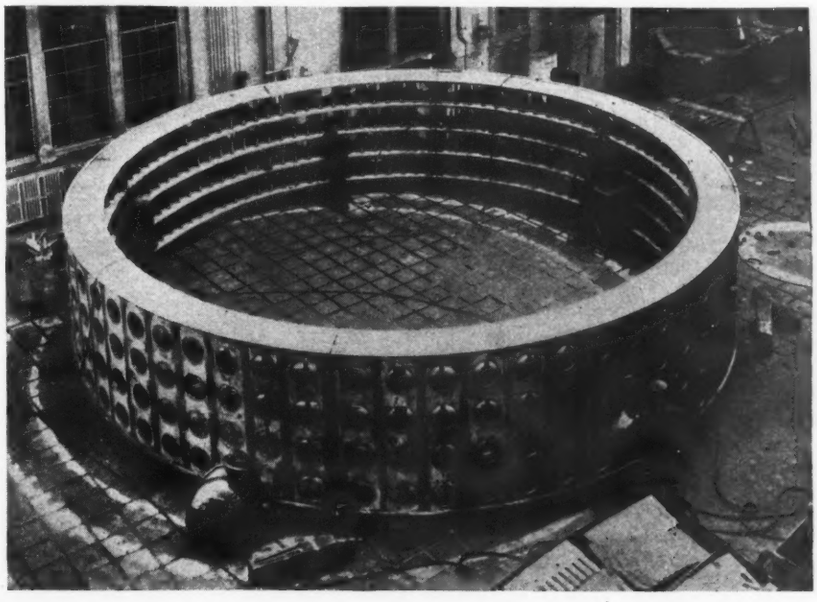
Flanders Nominated For A.S.M.E. Presidency

Nominations for officers of The American Society of Mechanical Engineers for 1935 were announced at a recent meeting of the Nominating Committee at Denver, Colo., during the Semi-Annual Meeting. Election will be held by letter ballot of the entire membership, closing Sept. 25.

The nominees, as presented by the Regular Nominating Committee of the Society, are: President—R. E. Flanders, president Jones & Lamson Machine Co.; Vice-Presidents—E. W. O'Brien, editor "So. Power Journal"; Jas. H. Herron, president Jas. H. Herron Co.; H. R. Westcott, president Westcott & Mapes, Inc.; Managers—B. M. Brigman, dean Speed Scientific School, University of Louisville; Alfred Iddles, vice-president United Engrs. & Constr., Inc.; J. W. Haney, professor University of Nebraska.

World's Largest Single-Phase Waterwheel Generator

The largest single-phase, 25-cycle, hydro-electric generator ever built is now under construction in the Schenectady plant of General Electric for installation at Safe Harbor. Here is the stator frame of this big machine, rated at 35,000 kva., 13,000 volts at 100 r.p.m. Power generated will be transmitted at 132,000 volts to the high-tension lines of the Pennsylvania Railroad at Perryville, Md., for use on their newly electrified divisions



Power Transformers Ordered For Boulder Dam

Eleven power transformers for Boulder Dam, seven rated 55,000 kva. at 287,000 volts, the highest commercial voltage of any transformer ever built in the United States, will be manufactured at the Pittsfield, Mass., works of General Electric under the terms of a Federal contract. Shipment of the transformers, valued at about $1,000,000, is scheduled in about a year.

The larger transformers are water-cooled, will weigh over 400,000 lb. each, and are approximately 32 ft. high, 20 ft. wide(and 13 ft. deep. The four smaller ones are rated 13,333 kva. at 138,000 volts and are forced-oil cooled.

Foster Wheeler Acquires Ruths Steam Storage

Foster Wheeler Corp. has taken over exclusive rights for the sale and manufacture of the Ruths Steam Storage Systems in the United States and Canada. Ruths accumulators will complement the present extensive line of Foster Wheeler power plant equipment. G. M. Cameron, formerly manager of Ruths Steam Storage Co., will be manager of the Ruths Accumulator Division of Foster Wheeler.

Boiler Manufacturers Meet at Skytop

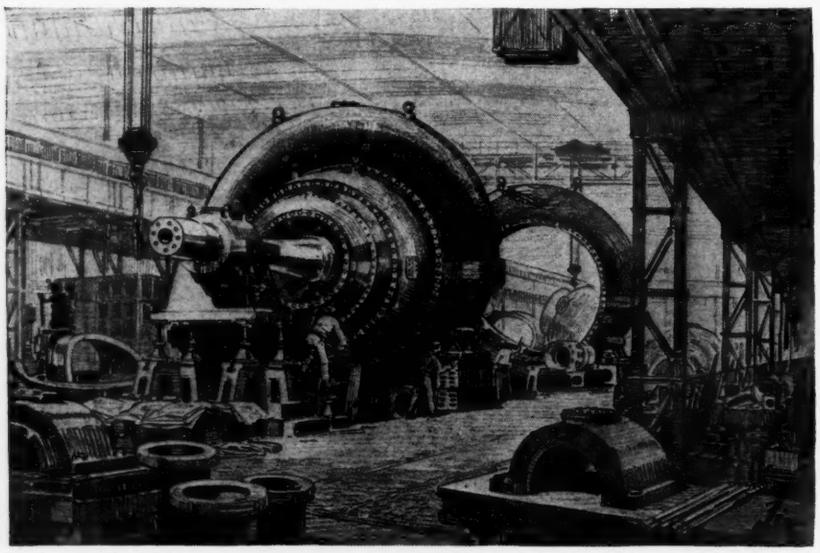
The American Boiler Manufacturers Association held its 46th annual convention at Skytop Lodge, Skytop, Pa., June 11-14. The program included an executive committee meeting, regular business, Code Authority business and group meetings. For Code purposes, the name of the organization is American Boilers Manufacturers Association and Affiliated Industries, thus including builders of boilers, stokers, pulverized-fuel equipment, air preheaters, and superheaters.

New officers of the association are: Owsley Brown, president Springfield Boiler Co., president; Starr H. Barnum, vice-president Bigelow Co., vice-president. Members of the executive committee include: F. H. Daniels, president, Riley Stoker Corp.; A. C. Weigel, consulting engineer; M. E. Finck, secretary, Murray Iron Works; A. G. Pratt, president, Babcock & Wilcox Co.; Walter F. Keenan, Jr., Foster Wheeler Corp.

Anniversaries

Several American companies are celebrating fiftieth anniversaries this year; one is celebrating its seventy-fifth. This is the old Holly Mfg. Co., Buffalo, N. Y., later merged with Snow Steam Pump Works to become the Snow-Holly Works of International Steam Pump Co., later the Snow-Holly Works of Worthington Pump & Machinery Corp., and recently designated the Buffalo Works of that company. The parent company was a builder of large steam pumping engine and built a number of heavy reciprocating machinery plants. Later production included large gas engines and still later diesel engines, laying the groundwork for the present Worthington line.

Prominent among 50-year-old companies is Whiting Corp., Harvey, Ill., with John Hill Whiting, the founder, still active as chairman of the board. The first name of this company was Whiting Foundry Equipment Co., and it first built cupolas and foundry equipment. Among companies taken over by Whiting are Swenson Evaporator Co., Grindle Fuel Equipment Co. and Joseph Harrington Co.



A Hundred Years With Sulzer

Machining 33,000-hp. centrifugal pumps for a pumped-storage plant. To deliver 162,350 g.p.m. against 545-ft. head, they are being built by Sulzer Bros. of Winterthur, Switzerland, which this year is celebrating its hundreth anniversary. As early as 1850, Sulzer was building steam engines, by 1900 was developing diesels and high-lift pumps. Today the company is one of world's largest diesel builders and also produces many other types of power equipment

Corrections

In the Power Maintenance Manual, the statement is made on page 42 that pulverizer maintenance costs 4 to 7 cents per ton of coal burned. This should obviously be 4 to 7 cents per ton of coal milled, as is explained in following sentences.

In the article, "Firebox Boiler Fired by Chain Grate Stoker," page 179, April number, statement is made in the next to the last paragraph that the cost of steam was computed at $3.60 per thousand square feet of radiation for the season. This should, of course, be $36. The cost of heating Columbus Avenue School last year being $1,117.60. The data for Columbus Avenue School was figured thus: "Tons of coal $\times$ cost per ton $\div$ heating load in feet $=$ cost per 1,000 ft., or 220 $\times$ 5.08 $\div$ 31 $=$ $36. The same figure applies to Cleveland Avenue School.

BUSINESS NOTES

Acheson Oildag Co. has changed its name to Acheson Colloids Corp.

Fisher Governor Co., Marshalltown, Ia., has appointed Weeks Engrg. Co., 4005 Gravois Ave., St. Louis, Mo., as factory representative for the St. Louis territory.

Jeffrey Mfg. Co., Columbus, Ohio, has appointed George C. Bowers representative in Minnesota, North Dakota, and South Dakota. His offices are at 311 Third Ave. South, Minneapolis.

Edward Valve & Mfg. Co., Inc., East Chicago, Ind., has appointed McGregor Engrg. Co., 213-14 Midco Bldg., Tulsa, Okla., as representative in Oklahoma, northern Arkansas and the Texas Panhandle.

Tippens & Sprengle, Inc., has moved to the Koppers Bldg., Pittsburgh.

Evans Elevator Equalizer Co. has moved its offices to 10-27 46th St., Long Island City, N. Y.

Diamond Power Specialty Corp., Detroit, Mich., has appointed Arthur E. Jones Co., Lafayette Bldg., Buffalo, N. Y., as representative.

Link-Belt Co., Chicago, has opened a warehouse at 413-15 Second Ave., Dallas, Texas. E. G. Wendell is resident manager.

Combustion Engineering Co., Inc., New York, N. Y., and D. J. Murray Mfg. Co., Wausau, Wis., have concluded an agreement for joint development, manufacture and sale of the improved Murray-Waern Chemical Recovery System. This system applies to the soda and sulphate pulp and paper manufacturing processes. Its particular advantage is that it provides, in conjunction with a well-established method of chemical reclamation, necessary equipment for highly efficient heat recovery with correspondingly large production of high-pressure steam. Approximately 10,000 lb. of steam is produced per ton of pulp, about twice the maximum steam production obtained from recovery systems in common use.

Riley Stoker Corp. has moved its Philadelphia office to Room 1434, 12 S. Twelfth St.

PERSONALS

Wm. E. Umstattd has been elected president of Timken Roller Bearing Co., Canton, Ohio, to succeed H. H. Timken, resigned. Mr. Timken remains as chairman of the board. Mr. Umstattd has been with Timken since leaving the Army in 1919, lately as factory manager and executive vice-president. Harry H. Timken, Jr., was elected a vice-president.

K. F. Cramer, with McIntosh & Seymour Corp., Auburn, N. Y., for a number of years, has been appointed manager for the Chicago district. Headquarters will be at 909 McCormick Bldg. for the states of Wisconsin, Michigan, Illinois, Indiana, Ohio and Kentucky.

B. J. Cross, who from 1921 to 1931 was associated with the engineering activities of Combustion Engrg. Corp., rejoined the engineering department of the present organization, Combustion Engrg. Co., Inc., May 1. He will be engaged in development and research work under direction of John Van Brunt, vice-president in charge of engineering, and of Henry Kreisinger.

Frank R. McNinch has been given a recess appointment for another term as a member of the Federal Power Commission.

William H. Bassett, metallurgical manager of American Brass Co., Waterbury, Conn., has been elected president of the American Society of Testing Materials. H. S. Vassar, laboratory engineer of Public Service Electric & Gas Co., Irvington, N. J. has been elected vice-president.

W. J. O'Brien, vice-president and general manager of Memphis (Tenn.) Power & Light Co. since Feb. 15, 1927, has been elected president.

Clyde L. Seavey, the new member of the Federal Power Commission, expects to take up his new duties Aug. 15. That much time will be required for him to wind up his work with the California Railroad Commission.

OBITUARIES

Daniel M. Bradley, 63, chief engineer of the Taunton (Mass.) municipal lighting department since 1920 and previously for 15 years a steam-turbine erection engineer by Westinghouse and General Electric, died at Oaks Bluffs, Mass., June 7.

Leonard J. Farrell, chief engineer of Public Service Co. of New Hampshire and superintendent of the Brook Street station of the company in Manchester, died suddenly at his home in that city May 14. He was born in Dushore, Pa., in 1861, and had been in the employ of the company and its predecessor, the Manchester Traction, Light & Power Company, since 1897.

H. J. Hawkshaw, for 32 years superintendent of construction for G. M. Gest, New York, and who supervised the installation of hundreds of conduit systems in this country, died June 14. For the past five years he has been in the Cincinnati office of the company.

C. E. Golden, president of Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., which he organized in 1905, died suddenly April 9. Mr. Golden was a pioneer in the development of automatic valve control in the steam and water service field and contributed much to engineering practice in developing efficiency, economy and safety by the use of automatic valves. He was president of the corporation since its inception.

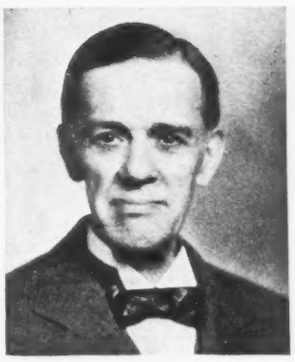
Edward M. Hewlett, 68, veteran engineer of General Electric Co., who retired from active service in 1931, died at his home in Schenectady, May 24. Mr. Hewlett began his career with Thomson-Houston Electric Co. at Lynn, Mass., in 1890, predecessor of GE. Mr. Hewlett was for many years engineer of the Switchboard Dept., and since 1927 consulting engineer.

Herbert A. Barre, 59, chief engineer of Southern California Edison Co., Ltd., and for many years an outstanding figure in the construction and operation of southern California electrical power supply, died suddenly June 28 at his home

in Los Angeles, Calif. Mr. Barre was largely responsible for the successful construction and operation of the first 150,000-volt long-distance transmission line in the world, between the hydro-electric plants of the Edison company's Big Creek-San Joaquin River development and Los Angeles. Later, and again under Mr. Barre's supervision, the conversion of these lines was effected for operation at 220,000 volts. This was in 1923.

William Mitchell McKee, 58, president of Chaplin-Fulton Mfg. Co., died at his home in Pittsburgh, April 26.

Prof. Cecil H. Peabody, 79, one of the foremost authorities on steam engineering and thermodynamics and author of a number of notable textbooks and steam tables, died in Boston, May 4, after a short illness. At the age of 23 he was professor of mathematics at the Imperial Agricultural College, Sapporo, Japan, and three years later became assistant professor of mechanical engineering at the University of Illinois. In 1883 he joined the staff of the Massachusetts Institute of Technology (his alma mater) as assistant professor of steam engineering and remained at the institute until his retirement in 1920 as professor emeritus of naval architecture. He was made first head of the latter department upon its organization in 1893.

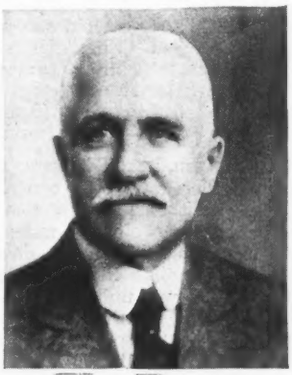


Edson O. Sessions, 62, president of E. O. Sessions Co., Ltd., consulting engineers of Chicago, died April 15. He first worked with General Electric, then with Stanley Electric, then back with General Electric when Stanley was absorbed. After organizing several manufacturing companies he entered consulting engineering practice, where he made outstanding contributions to industrial power economics, patenting switching equipment and leading in the use of high-temperature air for combustion with underfeed stokers.

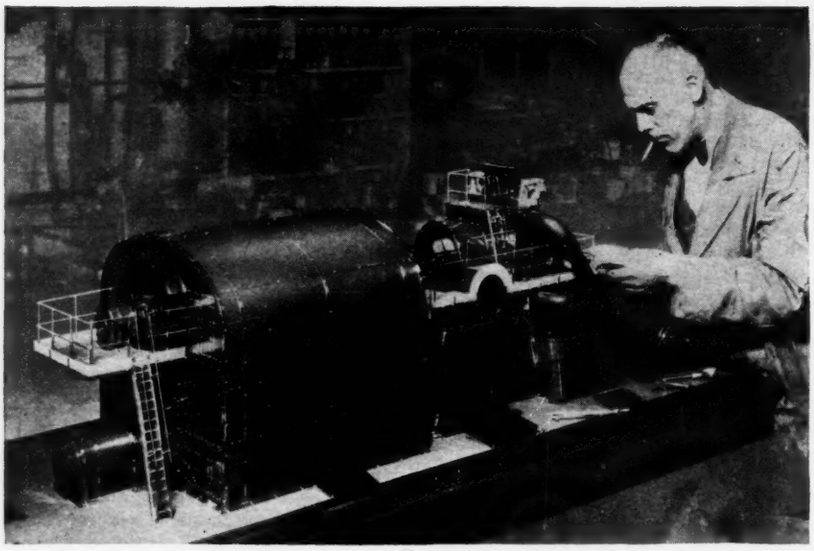
James R. Tiffany, 41, a power plant specialist in the sales department of the Boston office of the Westinghouse Electric & Mfg. Co., died at the Chester Hospital, Cambridge, Mass., May 14, following an accident.

Frank Herbert Thicke, 49, for many years head electrician for Canadian Collieries, operating in various parts of Vancouver Island, B. C., died at his home in Saltair, near Ladysmith, B. C. He was born in England.

James L. Robertson, Sr., 91, one of the first and best known men in the packing and steam specialty business in New York, died May 3 at his home in South Orange, N. J. Born in Trenton, N. J., he was a graduate of the old Trenton Academy and was later a soldier of the Civil War. In 1875 he organized the Eureka Packing Company.



He also founded the well-known firm of James L. Robertson & Sons, which for fifty years made and sold steam specialties. He was president of both companies until his retirement eight years ago. Mr. Robertson was a great lover of nature, and spent much time, in his early days, in fishing, hunting, and outdoor life. He had a host of friends who admired him for his genial disposition and ever ready interest in their affairs.



Model of Largest Industrial Turbine

Presented to Henry Ford by General Electric, builder of the original machine, this working model of the largest industrial turbine-generator will be a part of the Ford exhibit at A Century of Progress. The model is 1/64th the linear size of the 110,000-kw. vertical-compound original built in 1930 and now at Ford's Rouge Plant

STRAWS

Pointing the way business winds blow

Mesta Machine Co. has ordered almost a million dollars' worth of steel-mill electrical equipment from Westinghouse for a 76-in. strip mill being built for Youngstown Sheet & Tube Co. Included are six 3,500-hp. motors. This is the largest single order of its type since 1929.

Bureau of Reclamation, Los Angeles, Calif., will receive bids until July 26 for construction of the Parker dam and appurtenant works for power development, Parker Dam Project, California-Arizona. Work will include spillway gates and hoists, 12,000-ft. electrical metal conduit, metal pipe and fittings, etc. (Specification 574).

Fort Peck Dam, near Glasgow, Mont., is already under way. To control the flow of the Missouri River, this dam will create a reservoir 175 miles long and will cost $72,000,000. The dam will be nearly four miles long, the largest earth-fill barrier ever undertaken. Present plans include installation of a 100,000-hp. hydro-electric plant, with provision for future installation of thirteen 33,300-hp. units, a total of 532,000 hp.

Hastings, Neb., has just opened bids for a complete steam-generating plant, including boiler and all auxiliaries. Black & Veatch, 701 Mutual Bldg., Kansas City, Mo., engineers.

Stanolind Oil & Gas Co., Salt Lake City, Utah, plans installation of a new 4-in. welded steel pipe line from properties in the Iles oil field district, Colorado, to Craig, Colo., and vicinity, a distance of about 60 miles. Project will include booster pumping stations and auxiliary field structures, and is estimated to cost close to $200,000 with equipment.

Department of Public Works, Detroit, Mich., has plans for extensions and improvements in waterworks station at Connors Creek, to include installation of new pumping machinery, boiler unit and accessory equipment. Work is estimated to cost about $60,000 with equipment.

Booker, Texas, is arranging financing for $42,000 for a proposed municipal electric light and power plant. A municipal ice-manufacturing plant is also proposed.

Parsons, Kan., is arranging a special election in August to approve a bond issue of $275,000, fund to be used for construction of a municipal gas plant and distribution system. Plans will soon be drawn.

Alexandria, La., will receive bids until July 17 for extensions and improvements in municipal electric light and power plant, including three 7,500-sq.ft. boiler units, with superheaters and accessory equipment; three boiler feed pumps, feed-water heater, two forced-draft fans, two fuel-oil heaters and pumps; also for reconditioning present steam-turbine unit, and installation of certain equipment for replacements in existing station, including boiler feed pump and superheaters; and for reinforced concrete stack, 9 ft. dia. and 175 ft. high.

Auburn, N. Y., will ask bids at early date for equipment for proposed electric light and power plant, including diesel generating units and accessories, transformers, switchboard and instruments, and auxiliary equipment. A new street-lighting system will be installed. Fund of $310,000 has been secured for project through Federal aid. Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

Canton, Miss., is planning early purchase of natural gas properties in the Jackson County field, for development for municipal supply. A main trunk pipeline will be built to city, with compressor plants for booster service, and smaller diameter steel pipeline for distribution in city limits. A bond issue of $160,000 has been authorized.

Old Tavern Brewing Co., 1804 East 55th St., Cleveland, Ohio, has plans for a new boiler plant on adjoining site, former industrial building to be remodeled and equipped with boilers, stokers and auxiliaries. Raymond D. Parson, 2008 Keith Bldg., city, is architect.

Watab Pulp & Paper Co., Sartell, Minn., will carry out extensions and improvements in power plant, including installation of a new 1,500-kw. turbo-generating unit, for which contract has been awarded to Allis-Chalmers Mfg. Co. Awards for other equipment will soon be made. Entire project will cost over $150,000, including expansion in paper mill.

Madison, Wis., will ask bids in sixty to ninety days for a new pumping plant and reservoir for municipal water system, equipment purchases to include two motor-driven centrifugal pumping units, each with rating of about 2,500 g.p.m.; two air compressors and auxiliary equipment, including about 3,000 ft. of large-diameter pipe. Work is estimated to cost close to $100,000. Leon A. Smith is superintendent of water department.

M. K. Goetz Brewing Co., Sixth St., St. Joseph, Mo., plans installation of boiler plant in new multi-story brewery at 17th St. and Indiana Ave., Kansas City, Mo., where site was recently purchased. It will cost about $450,000. George L. Lehle, 111 West Washington St., Chicago, Ill., architect and engineer.

PWA Board of Review, after study and public hearings on the application of a private corporation for $47,000,000 allotment for developing a tidal power plant and aluminum and stainless steel plant at Passamaquoddy, Me., has reported, "The Board is of the opinion that from an economical standpoint the time has not yet arrived for the development of this project." The project, known as the "Quoddy tide trap" is one which has long been promoted as a pioneer effort to develop hydro-electric power by harnessing ocean tides. The Board found that the cost of "Quoddy" power, as compared with the cost of hydro power from undeveloped rivers in Maine, or with steam power from the New England seaboard, would be unfavorable to "Quoddy," and that there does not exist at the present time a market for such a large block of additional power.

Solvay Process Co., 61 Broadway, New York, N. Y., plans construction of a group of power and mechanical units at new alkali plant on waterfront at Baton Rouge, La., where a large tract of land has been acquired, including power plant, transformer station, electric-operated pumping plant, water-treating works and distributing pipe lines. Project will cost over $2,500,000 with equipment.

Moberly, Mo., has called a special election Sept. 11 to approve bonds for $566,000, fund to be used for a new municipal electric light and power plant, including improvements in present station. Project will cost about $700,000, and will include installation of two 2,000-kw. turbo-generator units with accessories, two 2,360-sq.ft. boilers, boiler feed pumps, feedwater heater and auxiliary boiler room equipment; also, switchboard and instruments, transformers, etc. Extensions will be made in electrical distribution system, including construction of new lines. Russell & Axon, 4903 Delmar Blvd., St. Louis, Mo., consulting engineers.

No. 1 Mill of American Boxboard Co., Grand Rapids, Mich., is being electrified by Westinghouse at a cost of $120,000. The modernization is expected to pay out in three years. Equipment includes a 3,000-kw. condensing bleeder-type turbine-generator, a 1,950-sq.ft. condenser, single-motor paper machine drive equipment, five 100-hp. motors and five 60-hp. motors.

District of Columbia has received an $8,000,000 PWA allotment for a sewage disposal plant, to be built at Blue Plains, D. C.

S. B. Foot Tanning Co., Red Wing, Minn., is having plans and specifications prepared for a complete new power plant. Geerlings & Henschel, Milwaukee, Wis., are engineers.

American Box Board Co., Grand Rapids, Mich., has replaced four small turbines and three steam engines with a new 3,000-kw. Westinghouse unit at its No. 1 mill. High-speed squirrel-cage gear motors are being substituted for low-speed slip-ring units to lift plant power factor above 80 per cent. The changeover, to be completed early in September, is expected to save $45,000 a year and to pay out in three years.

Chilton Malting Co., Chilton, Wis., is having plans and specifications prepared for complete new boiler plant. Geerlings & Henschel, Milwaukee, Wis., are engineers on the project.

Tennessee Valley Authority is planning to expand its plans by $48,000,000, to make the total expenditure $310,000,000 instead of the $50,000,000 originally proposed. The latest addition is for a dam on the lower Tennessee River 50 or 60 miles from the confluence of the Tennessee and the Ohio in southwestern Kentucky. Southern Industries & Utilities Co. some years ago obtained a permit to develop power there, but has not made use of it. The new dam is to be called the Aurora.

Orders for three specially designed centrifugal pumps to handle dirty water, with a capacity of 330 g.p.m. against 125-ft. head, have been placed with John Redden & Co., Vancouver, B. C., by Yukon Consolidated Gold Corp., Dawson City, one of the largest operators of gold dredges in the Yukon. The pumps will be manufactured at the Redden plant and operated with 125-hp. Canadian General Electric motors.

Chase & Co., Sanford, Fla., will buy a 360- to 400-hp. diesel to augment its power plant. This plant, now 16 years old, is one of the most successful diesel plants in that section. W. A. Leffler is vice-president and general manager, W. A. Hooper is purchasing agent.

FEDERAL ALLOTMENTS

To	For	Loan and/or Grant	Total, Thousands of Dollars
Power Plants, etc.			
State Sanitarium, Wallum Lake, R. I.	Boiler & aux.	G	4
Okeene, Okla.	Diesel-electric plant	L & G	48
Territory of Hawaii,	Heating blr., etc.	G	53.2
Greenwood City, S. C.	15,000-kw. hydro plant	L & G	2,767
Osceola, Ark.	750-hp. diesel-electric	L & G	52
Jenkintown, Pa.	Boiler replacement	L & G	14.8
Wapakoneta, Ohio	Two 750-kw. turbo-genrs.	L & G	146
Monroe City, Mo.	275-kw. & 110-kw. diesel-genrs.	G	17
Hannibal, Mo.	7,500-kw. turbo-genr.	G	81
Independence, Mo.	Air preheater, spray pond, etc.	G	52.5
Worthington, Minn.	1,250-kva. turbo-genr.	G	29
Dept. Correc., N. Y. State	Power plant, Elmira Ref.	G	162
Chicago, Ill.	Rep. Lockport hydro plt.	G	230
Highland, Ill.	1,875-kva. turbo-genr.	G	25
Trenton, Mo.	Two 500-kw. & 300-kw. diesel-genrs.	L & G	315
Canton, Miss.	Gas transmission line	L & G	168
Holmes City, Miss.	School heating system	G	.34
Memphis, Mo.	235-kw. diesel-genr.	G	8.5
Troy, Ala.	Butane plt. & mains	L & G	68.4
R. I. Inst., Howard, R. I.	Add'l boilers & aux.	G	11.8
Sibley, Ia.	4,000-sq. ft. boiler, etc.	L & G	26
Watseka, Ill.	Butane plt. & mains	L & G	64.6
Waterworks & Pumps			
Lexington, Okla.	Waterworks & pumps	L & G	15
Perry, Mo.	Waterworks & pumps	L & G	56
Elliott, Ia.	Waterworks imp.	L & G	3.6
Morrisonville, Ill.	Waterworks imp.	L & G	31
Paris, Ill.	Waterworks imp.	L & G	52
Elmhurst, L. I.	Waterworks imp.	L & G	66
Martello, Ia.	Waterworks & pumps	L & G	15
Frederick, S. D.	Waterworks & pumps	L & G	19
Littlefield, Tex.	Waterworks imp.	L & G	48
Kerens, Tex.	Waterworks imp	L & G	83
Uniontown, Ky.	Waterworks & pumps	L & G	76
LaPorte, Ind.	Waterworks imp.	L & G	190
Hinsdale, N. H.	Waterworks & pumps	L & G	147
Vincent, Ala.	Waterworks imp.	L & G	28
Adrian, Mo.	Waterworks & pumps	L & G	49
Oswatomie, Kan.	Mun. water plant	L & G	85
Corning, Ia.	Sewage plt. & pumps	L & G	42
Bethany, Ill.	Waterworks & pumps	L & G	48
Amherst, Tex.	Waterworks imp.	L & G	5
Glenwood, Ark.	Waterworks system	L & G	53
Rock Hill, S. C.	Sewers & pumps	L & G	263
St. Paul, Minn.	Steam plt. for water	L & G	133
Forrest, Ill.	Waterworks imp.	L & G	32
Blackville, S. C.	Waterworks imp.	L & G	45
Delphos, Ohio	Waterworks imp.	L & G	43
Mound Valley, Kans.	Waterworks & pumps	L & G	45
Manchester, Ky.	Waterworks & pumps	L & G	54
Wentzville, Mo.	Waterworks & pumps	L & G	45
Evansville, Ind.	Sewers & pumps	L & G	1,172
Rosebud, Tex.	Waterworks imp.	L & G	21
Stanton, Tex.	Sewage pumps	L & G	34
Lancaster, Mo.	Waterworks & pumps	L & G	55
Cairo, W. Va.	Waterworks imp.	L & G	8
Maryville, Mo.	Sewage pumps	L & G	15
Lakeville, Minn.	Sewage pumps	L & G	23
Leesburg, Ohio	Waterworks imp.	L & G	21
Hebron, Ohio	Waterworks & pumps	L & G	47
Fletcher, Ohio	Waterworks & pumps	L & G	28
Arapaho, Okla.	Waterworks add.	L & G	3
Shawnee, Kans.	Waterworks & pumps	L & G	215
Harcourt, Ia.	Waterworks & pumps	L & G	19
Monett, Mo.	Waterworks imp.	L & G	32
East St. Louis, Ill.	Storm water pumps	L & G	2,360
Faison, S. C.	Waterworks & pumps	L & G	47
Deer Creek, Okla.	Waterworks & pumps	L & G	25
Cornelia, Ga.	Waterworks & pumps	L & G	90
Canal Winchester, Ohio	Waterworks imp.	L & G	13
Midway, Ky.	Waterworks & pumps	L & G	60
Quindaro Twp., Kans.	Waterworks & pumps	L & G	150
Fiarbury, Ill.	Waterworks imp.	L & G	55
McLeansboro, Ill.	Waterworks imp.	L & G	74
Midlothian, Ill.	Waterworks & pumps	L & G	40
Benton City, Tenn.	Waterworks & pumps	L & G	46
Dallas, Tex.	Sewage pumping	G	21
Holton, Kans.	Sewage pumping	G	10.2
Sun Prairie, Wis.	Sewage pumping	G	7.5
Oakland, Ia.	Water pumping	L & G	16
Velva, N. D.	Water pumping	L & G	6
Oskaloosa, Ia.	Waterworks imp.	L & G	95
R. I. Col. Agr., Kingston, R. I.	Waterworks imp.	G	2.5
Joliet, Ill.	Waterworks imp.	L & G	1,790
Crockett, Tex.	Waterworks imp.	L & G	76
Millport, Ala.	Waterworks & pumps	L & G	43
Sweetwater, Tex.	Waterworks imp.	L & G	160
Nokomis, Ill.	Waterworks imp.	L & G	45
Zion, Ill.	Waterworks imp.	L & G	17
Homewood, Ill.	Filters & pumps	L & G	52
Yadkinville, N. C.	Waterworks & pumps	L & G	44
Pinckneyville, Ill.	Waterworks imp.	L & G	26
Grand Rapids, Mich	Waterworks imp.	G	21
Fredericksburg, Tex.	Waterworks & pumps	L & G	228
Falkville, Ala.	Waterworks & pumps	L & G	29
Lebanon Jctn., Ky.	Waterworks & pumps	L & G	64
Smithton, Pa.	Waterworks imp.	L & G	13
Jackson, Ala.	Waterworks imp.	L & G	29
Moundville, Ala.	Waterworks & pumps	L & G	41
Worcester, Mass.	Sewage pumping	G	15
Waverly, Ia.	Sewers & pumping	L & G	90
Morenci, Mich.	Waterworks imp.	L & G	20
Sterling, Mass.	Waterworks & pumps	L & G	50
Drew City, Ark.	Waterworks imp.	L & G	21
Brookside, Ala.	Waterworks & pumps	L & G	24
Bowdon, Ga.	Waterworks imp.	L & G	20
Louisville, Ga.	Waterworks imp.	G	7
Ripley, Miss.	Waterworks & pumps	L & G	65
Blackshear, Ga.	Waterworks & pumps	G	2.1
Jet, Okla.	Waterworks & pumps	L & G	20

NEW BULLETINS

Coupling—D. O. James Mfg. Co., Chicago, Ill. 4-page bulletin describing James flexible coupling.

Motor-Generator Sets — Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin No. 1155, 24 pages, illustrated, describing motor-generator sets from 200 kw. to 6,000 kw.

Recorder—Bailey Meter Co., Cleveland, Ohio. 4-page Bulletin No. 140 describing 4-pen Galvatron recorder.

Step-Voltage Regulators — Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. 8-page bulletin describing Type UR automatic regulators, both single-phase and polyphase.

Circuit Breaker — General Electric Co., Schenectady, N. Y., describing pole-mounted automatic reclosing equipment.

Indicating Board—General Electric Co., Schenectady, N. Y. 4-page bulletin describing the Autelco power supervisor's indicating board

Compressors — Gardner - Denver Co., Quincy, Ill. Two bulletins. No. AC-7 describing air-cooled compressors and outfits and other information. Bulletin HAC-36 illustrating and describing duplex two-stage horizontal compressors.

Cranes—Whiting Corp., Harvey, Ill. 8-page illustrated booklet describing types of cranes and installations.

Motors—Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. 4-page leaflet on quiet-operating induction motors from ¼- to 50-hp.

Fire Brick — General Refractories Co., Philadelphia, Pa. Bulletin on Carbex silicon-carbide brick.

Modulators — Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. "Adjustment and Operation of Modulators," useful booklet on how to measure modulation accurately.

Stokers—Link-Belt Co., 2410 W. 18th St., Chicago, Ill. Book 1419, "Firing Method Modernized for Profit," describes automatic underfeed stoker, lists results in installations.

Belt Conveyor Idlers—C. O. Bartlett & Snow Co., Cleveland, Ohio, Bulletin 72 lists popular types, gives dimensions, prices, etc., and some engineering data on back cover.

Compressors & Condensers—Worthington Pump & Machinery Corp., Harrison, N. J. W-200-B2 supersedes W-200-S10 on surface condensers of the folded tube layer type in the welded steel shell design. L-612-S28 describes refrigeration compressors of the horizontal duplex type. These include single- and two-stage, belt-driven and direct-connected (to synchronous motor), all equipped with feather valves.

D.C. Motors—Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo. Two loose-leaf bulletin sheets, known as Bulletin 17, Part 8. Illustrate and give design and construction details.

Dust Hazards—Northern Blower Co., West 65th St. & Barberton Ave., Cleveland, Ohio. Series of monthly folders, summarizing and reprinting essential authoritative data.

Combustion Indicators—Ess Instrument Co., 30 Church St., New York, N. Y. Bulletin 341 illustrates and describes "electric eye" combustion indicators and combustion controls.

Fuse-Indicating Cutouts—L. S. Brach Mfg. Corp., Newark, N. J. Bulletin A on neon lamp indicators for fuses.

Coal Distributors—Stock Engrg. Co., Penton Bldg., Cleveland, Ohio. This company is now manufacturing and distributing the conical non-segregating coal distributor. 4-page bulletin describes principal characteristics.

Crane Engineering—Whiting Corp., Harvey, Ill. New house organ, "Crane Engineering Illustrated" shows applications of traveling cranes to industrial work.

Boiler Meters—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio. Bulletin 44-A "Savings Effected by Bailey Boiler Meters," 32 pages including actual operating data and savings, descriptions, illustrations, tabulation of plant data, etc.

Soot Blowers—Diamond Power Specialty Corp., Detroit, Mich. 4-page explanation of distinctions in types of soot blowers and preferable work for each type.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Hope — Municipality plans generator plant alteration and new generator. To exceed $40,000.

Calif., Lodi—City defeated $500,000 bond election for hydro-electric plant.

Colo., Fort Collins — City, bond purchase agreement has been signed by the government and city and condemnation proceedings started to obtain distribution system owned at present by a public utilities company, municipal light plant will be built at cost of $738,000. B. G. Coy, city engr.

Ill., Chicago—Cook Co., County Bldg., plans installing new complete electrical system, or repairing present system if possible of the Cook Co. Court House Building. $150,000. F. H. Chambers, supt. P. Wks.

Ill., Chicago—Sanitary Dist. of Chicago, 910 South Michigan Ave., plans replacing 2 hydro-electric 8,500 K.V.A. units and 2 exciters each 200 hp. and other miscellaneous work, at Lockport Lock on Sanitary Dist. Canal at Lockport. $800,000. P.W.A. grant of $205,200 approved. P. Harrington, c/o owner, engr.

Ill., Waukegan—Voters defeated plan to have survey made for municipal light and power plant. $500,000.

Ind., Angola—City making plans new diesel engine and generating outfit at city plant. $23,400.

Ind., New Palestine—Town plans municipal electric light plant. C. Herrlick, New Palestine, chn.

Idaho, Coeur D'Alene—City voted $600,000 bonds to secure P.W.A. Loan for municipal hydro-electric light and power plant.

Ia., Iowa City—City voted to establish, maintain and operate municipal light and power plant. $917,000. City officials may purchase existing plant or construct new one.

La., Alexandria—July 17, by Commission Council, J. H. Brewer, sec.-treas., municipal power plant improvements, involving **(1)** three 750 hp. boilers with superheaters and accessories, erected on customer's found. **(2)** 2 forced draft fans **(3)** 1 feed water heater **(4)** 3 boiler feed pumps **(5)** 2 fuel oil heaters and pumps **(6)** 2 Desuperheaters and pressure reducing valves, all deliverd f.o.b. Alexandria **(7)** all piping for steam, water, gas and oil, incl. valves, bends, fittings, furnished and installed also installation of Items 2, 3, 4, 5 and 6 **(8)** furnishing all equipment and labor and construct entire work, outlined in Items 1 to 7 inclusive **(9)** reconditioning steam turbine 4,000 kw. General Electric turbo-generator set **(10)** replacing steam turbine of 2,500 kw. General Electric turbo-generator set **(11)** exchanging present 2,500 kw. unit for new 2,500 kw. unit for revised conditions, 375 lb. gage, 700 deg. F. **(12)** exchanging present 2,500 kw. unit for new 4,000 kw. unit, for revised conditions, 375 lb. gage, 700 deg. F. **(13)** furnishing all equipment for entire work as outlined in Items 9 and 10 **(14)** furnishing all material and labor and construct rein.-con. chimney, interior diam. 9 ft. height, 175 ft. on customers pile found.. P.W.A. Project 1995. Est. $250,000 incl. boiler house.

Mich., Grand Ledge—Municipality, sketches electric power plant. Hamilton & Weber, Grand Rapids, engrs. To exceed $28,500.

Mich., Vicksburg—Village retained Francis Eng. Co., Saginaw, to prepare plans for municipal light and power plant. Approximately $30,000.

Minn., New Ulm—City plans alterations and improvements at municipal power plant, also furnishing, installing 2 Diesel engines. C. W. Franks, city engr., L. A. Breneman, 707 Builders Exchange, St. Paul, engr.

Mo., Advance—City withdrew P.W.A. application for $9,900 grant and $25,500 loan for light and power plant. $35,400. Project postponed indefinitely. Conzelman & Co., Title Guaranty Bldg., St. Louis, engrs.

Mo., Moberly—City postponed until September the election on a bond issue $566,000 for altering and constructing municipal light and power plant addition, incl. two 2,000 kw. turbo-generators, electric distribution system. P.W.A. allotted $700,000 grant and loan.

Mo., Plattonsburg—City plans power plant. $70,000. P.W.A. approved loan and grant. E. T. Archer & Co., 609 New England Bldg., Kansas City, engrs.

N. M., Moscalero—Indian Bureau, Wash., D. C., plans hydro-electric plant, and day school and community center, in White Tail, Carrizo and Elk Spring. $120,000. J. C. Cavill, agent.

N. Y., Auburn—City plans generating plant and street lighting system. $310,000 loan and grant approved by P.W.A. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

O., Columbus—Plans for extensions of municipal light plant at cost of $1,030,000 to be revised by Columbus Eng. Dpt. in order to get federal government under P.W.A. to approve $206,000 grant for work. Plan recommends 2 boilers and 1 generating unit and large condenser system. If project is finally approved by federal authorities a grant of $206,000 and purchase of $824,000 of city's bonds will be made by Federal Government. Bonds mature over period of 25 years starting in 1940. H. C. Worley, mayor.

O, Gallon—City plans municipal light plant improvements. $160,000. William C. Kammerer & Associates, 823 Prospect Ave., Cleveland, consult. engrs.

Okla., Muskogee—Election Nov. 6, $1,200,000 municipal electric light plant. Burns & McDonnell, 417 E. 13th St., Kansas City, Mo., engrs.

Okla., Pawnee—Voted $48,000 for electric light plant. J. A. McDaniels, Pawnee, engr.

Ore., Portland—U. S. Eng., Portland, cancelled bids to have been opened June 30, for turbines and governors, for Bonneville Dam. Will revise specifications and take new bids soon.

Pa., Coraopolis—Borough plans new power and light plant. Public Service Comn. outlaws $50,000 gift which Duquesne Light Co. offered to Borough so they would not erect their own plant. P. J. Loftus, Oliver Bldg., Pittsburgh, engr.

Pa., Easton—Metropolitan Edison Co. plans rebuilding hydro station, destroyed by fire, Abbot St. $30,000-$35,000.

Pa., Fleetwood—Borough Council plans municipal electric plant. $148,000. J. W. Maskell, 947 East Rittenhouse St., Phila., engr.

Pa., Gavre—Northern Pennsylvania Power Co. plans rebuilding substation and installing new equipment. $28,500 or more. Engineer not appointed.

Tenn., Knoxville—Bids July 17, at office W. W. Mynatt, city mgr., Knoxville, complete electric distribution sytem, Contr. 1, overhead system (Dist. 2), Contr. 2, meters; Contr. 3 transformers; Contr. 4, substation equipment. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., consult. engrs.

Tex., Goose Creek—City, c/o C. N. Myers, Goose Creek, authorized Inland Eng. Co., engrs., Dallas, to make survey and report on feasibility of municipal light and power plant and hospital.

Tex., Waco—City, c/o N. O. Hultgren, mgr., plans municipal power and light plant.

Utah — Cities of Tropic, Cannonville and Henryville plan hydro-electric power plant. Applied for $32,000 P.W.A. loan.

Wis., Madison — City, A. W. Barns, clk., plans 500,000 gal. rein.-con. reservoir, 2 motor driven centrifugal pumps, 2 air compressors, and connecting pipe line. $100,000. Engineer not appointed.

Alta., Calgary—Calgary Power Co. preparing plans for dam at Kananskis Lake. $150,000.

B. C. Dolarton—Canadian Robert Dollar, Ltd., soon takes bids power house, boiler house and other structures.

B. C., Victoria—Victoria Steam Heating Co. Ltd., P. Fox, archt., making plants central heating plant, Wharf St. $200,000.

N. B., Nelson—New Brunswick Power Comn., Fredericton, N. B., bids in July, for construction of step-down transformer station, 66,000-6,600 volts. E. A. Reilly, chn.